The FOUNDRY

Volume 48. No. 2
Whole No. 339

Published
Semimonthly

CLEVELAND, OHIO, JANUARY 15, 1920

Making Rubber Mold Castings

Situated in a City Acknowledged to be the Greatest Rubber Manufacturing Center in the World, Iron Foundries Have Developed Special Facilities for Producing the Required Castings

BY PAT DWYER

WHEN the immortal bard penned the lines "There is a tide in the affairs of men which taken at the flood leads on to fame and fortune," and put them in the mouth of the man who conspired against mighty Caesar, he gave utterance to a thought and put into words a sentiment that antedated by many centuries the stirring days of the Roman empire. The truth of the sentiment has been exemplified in every age and in every land and perhaps in none more frequently than in these United States of America during the past century. 'Tis true that when Marcus Brutus expressed himself he had in mind certain warlike deeds, but it is also true that there are numerous instances of men who believed as he did and launched themselves on the uncertain tide of commercial and industrial life without any assurance that the tide was on the flood and would bear them into the haven of success and security. The careers of the late Andrew Carnegie and H. C. Frick are cases in point. They embarked on the tide when it was just beginning to flow and with other sturdy navigators found themselves carried along on a flowing flood of steel which yielded them for-

FIG. 1—A FLOOR OF MOLDS FOR AUTOMOBILE TIRE CORES—THE LUGS AT THE SIDES OF THE FLASKS ARE TAPERED AND NO WEDGES ARE NEEDED TO TIGHTEN THE CLAMPS

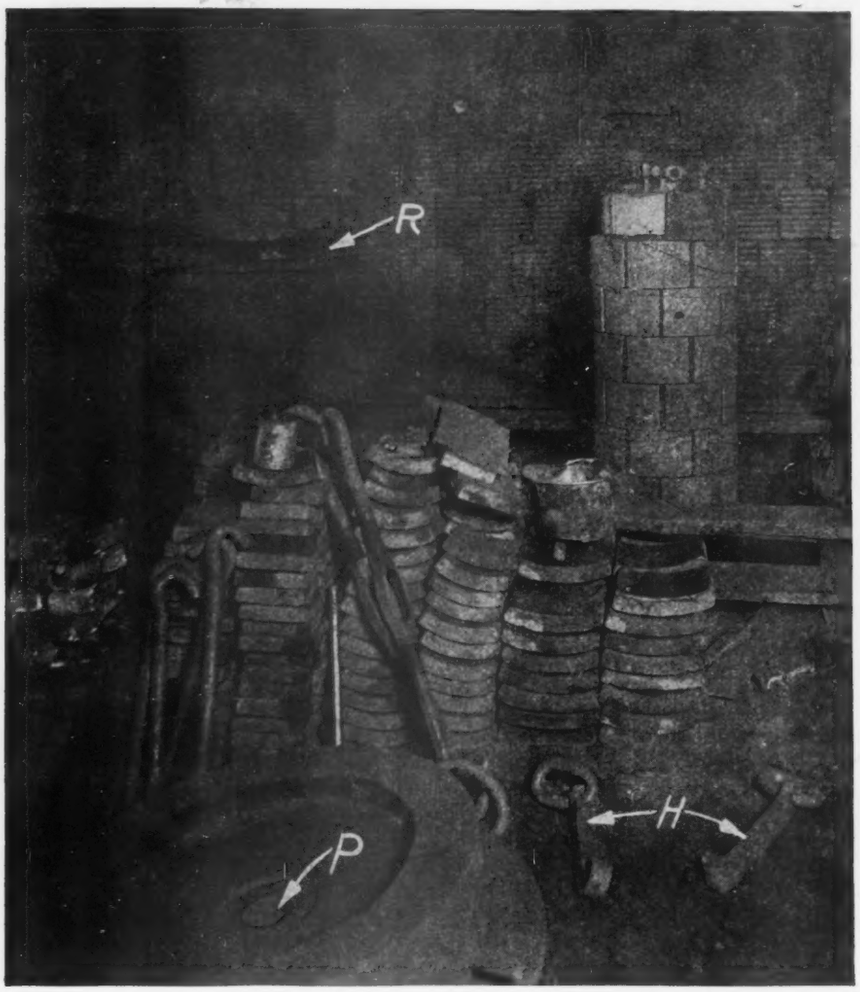


FIG. 2—THE ROLL PIT IN WHICH LONG CYLINDRICAL CASTINGS ARE MOLDED AND POURED

tunes unparalleled in the history of the world.

Since the base of all industrial life rests on iron it is only natural to find that the growth and expansion of the huge industrial enterprises have had a corresponding effect on the casting industry. Iron, steel, coal mines, railroads and motor car factories all need castings to carry on their operations and many foundries trace their origin, subsequent progress and growth to the expansion of the particular business to which they cater. Within the past decade immense rubber factories have been established at Akron, O., for the manufacture of automobile tires and their casting requirements absorb the output of several foundries.

Tire Molds Prove Attractive

Attracted by the possibilities of the business in the early days, four molders and a coremaker organized the Atlantic Foundry Co., in 1905, and leased a small foundry of 5 tons capacity. At the end of six years the company owning the property and needing it for their own use brought the lease to a close. The Atlantic Co. then built a new foundry of about 15 tons capacity on the premises where it now is located. An addition was built to the new shop at the end of two years and when two years more had elapsed the business had grown so much that a still larger addition was found necessary. In 1917 the company purchased the buildings of the Ford Foundry & Heating Co., Cuyahoga Falls, O., and now operates both plants. In 1918 a steel foundry, 100 x 100 feet, was built and equipped at an approximate cost of $250,000 for the production of electric steel castings.

Although built on a plot of ground adjoining that on which the iron foundry is situated it is operated independently and is a complete self-

FIG. 3—WHERE THE COPES ARE MADE, SHOWING A FINISHED COPE, A CORE, ONE OF THE PATTERN BOARDS AND THE JAR MACHINE

contained unit. The steel is melted in a 3-ton Snyder electric furnace manufactured by the Industrial Electric Furnace Co., Chicago. A monorail track is used for carrying the material for the charge from the yard to the furnace.

The company which started out so modestly a few years ago, today is capitalized at $500,000 and does a business of $1,000,000 a year. Of the five original incorporators three men, the president and two vice presidents, still are interested actively in the management of the company.

How Tires Are Made

Automobile tires are made in iron molds. The process varies in some particulars depending on the style of tire and the established practice in different factories. It may be described briefly as follows:

A hollow cast iron ring conforming to the inside shape of the tire, either in one or four pieces, is mounted on a revolving spindle and the fabric for the tire is stretched upon it and pressed down closely by a series of rollers. The tire, with the cast iron core still in place, is taken off the machine and lowered into a cast iron half mold which is to form the outside surface and also indent the figures of the wheel tread. An upper half mold which has been suspended is lowered and then the entire load with several others is delivered to the vulcanizing vessel where it is brought to a predetermined heat and then squeezed by a hydraulic press.

FIG. 5—MOLD READY FOR CLOSING, SHOWING STYLE OF STRAINER GATE AND VENT

The method the Atlantic Co. follows in making the castings for the interior core of the tires is shown in Figs. 3 and 5. It is interesting to note that a gang of six men make 50 molds a day. The gang is composed of one crane man, one coremaker, one man coring the molds and making up the runners, one man

FIG. 4—THE GROOVE IN THE LOWER SIDE OF THESE MOLDS IS FORMED BY A CHILL RING WHICH SERVES TO CLOSE THE GRAIN OF THE IRON

ramming drags and two men making copes. All the operations in connection with making these molds have been studied carefully and all surplus or unnecessary labor is eliminated. Making up the runners is a case in point. When the cope is set, the man whose duty it is to look after this part of the job drops a runner stick into the gate, places his runner box and throws in a shovelfull of sand. He then takes a block which is cut to the conventional shape of a runner basin, having a hole near one end to accommodate the gate stick. This block is lowered into the soft sand in the runner box and pressed down firmly. Two more shovelsfull of sand are then thrown into the box and rammed lightly with the shovel handle. The surplus sand is scraped off, the block withdrawn and the runner is ready for the iron.

For greater efficiency and freedom of movement the drag machine is situated at one end of the floor and the cope machine at the other. The drags are barred as well as the copes eliminating the necessity for using bottom boards. When shaking-out the molds at night the sand from all the drags is dumped in a heap near the drag machine and the empty flasks are piled nearby. The same treatment is accorded the copes at the other end of the floor. Long handled, two-prong forks with the prongs bent at right angles are found useful for removing the gaggers from the cope sand pile. No gaggers are used in the drag because the mold board is clamped on and turned over with the flask. One of the cores for the rings is shown at *C*, Fig. 3. These cores are made in halves from an oil sand mixture and pasted. One set of half cores is made first, each half containing a No. 5 gage wire ring for a stiffener. When they are dried they are taken from the oven and each one *topped off* with a green half from the same corebox. To vent this core a narrow channel is cut in the joint of the green half extending for 8 or 10 inches on each side of the print. A short piece of ¼-inch pipe is inserted to form the core print before the two halves are pasted together. As in the case of the hydraulic ram referred to later the short piece of pipe is removed when the casting is cleaned and a plug screwed in the hole before the casting is machined.

FIG. 6—THIS FLASK HAS SEVERAL SPECIAL FEATURES—NOTE THE SAND STRIP AROUND THE RIM, ALSO AROUND THE CENTER—THE SPLIT IN THE CENTER PROVIDES FOR EXPANSION AND CONTRACTION—DOUBLE PIN LUGS ASSURE ALIGNMENT OF COPE AND DRAG—TAPERED CLAMP LUGS ELIMINATE THE USE OF WEDGES

The two chief requisites of these castings are that they be close-grained and absolutely clean. They are machined all over and the least blemish is enough to condemn them. The machined sizes are held within the most rigid limits. When they are in use they are scrubbed with steel wool each time a tire is made on them and small as the wear is, it is sufficient to render them useless in a comparatively short time. A tolerance of only 0.006-inch is allowed.

The depression in that part of the mold which is used to form the outside face of the tire is cast against an iron chill. The silicon content of the iron used for these castings averages about 2.50 per cent and, therefore, the face of the casting is not actually chilled as chilling is understood in the foundry. The grain of the iron is rendered quite close and dense, but it can be machined.

The outside surface of hydraulic rams made in this shop are rendered close and dense by a similar process. The molds for these castings are made on end in round iron flasks. Small concave iron blocks, 8 x 8 x 2 inches, a number of which are shown in Fig. 2, are built in tiers up against the pattern and heap sand rammed in between them and the wall of the flask. In other words they simply take the place of the usual thickness of facing sand and as a result when the pattern is drawn the wall of the mold consists of a cast iron skin 2 inches thick. The top part of these castings with the flask removed and the chill blocks still in place is shown in Fig. 2. The entire casting is 18 feet long by 2 feet in diameter with a metal thickness of 3 inches. One end is open and the other end is closed, the closed end is cast down. The casting is shown standing in a pit 14 feet deep, 10 feet long and 6 feet wide. A completed mold for another ram casting is shown standing alongside in the same pit. These castings are poured from the top, eighteen ¾-inch pop gates connecting the mold with the pouring gate.

The core for this type of casting is split longitudinally and made in a half box. The two halves are made, dried and assembled in a horizontal position then the entire core is up ended by one of the cranes and lowered vertically into the mold. Each half of the core is reinforced by four long pieces

of 2-inch pipe and suitable hooks are provided at one end for attaching the crane. Since one end of the casting is closed and furthermore, since this end has to be cast down to insure solidity on the working end of the ram, provision was made for locating and securing the core. The usual alternatives in such cases would have been either to suspend the core from the cope or let it rest on chaplets on the bottom face of the mold. Neither of these plans appealed to the management so another method was adopted which has proved highly effective.

Before the two halves of the core are assembled they are laid side by side horizontally on a pair of horses. The joint of one half is turned up and the joint of the other half is turned down. Each half contains a 4-inch core print 2 feet long in the end which will be down when the casting is poured. This print is provided to hold a piece of 4-inch shafting, 3 feet long, which in turn is destined to center and sustain the weight of the entire core when it is in position in the mold. The short shaft is set in the print of the half core whose joint is turned up. The inner end is brought in to contact with a short iron plate which has been rammed up in the core for that purpose, while the other end projects about 12 inches. Paste is applied to the joint of the core and also daubed on the piece of shaft and then the other half of the core is picked up and lowered on. The two halves of the core are then bolted together, the joint daubed with slurry and the bolt holes filled with sand. The completed core is then given a coat of blacking and run into the oven for a final drying.

After drying the entire core is upended and lowered into the mold. The piece of shafting enters a core print 8 inches deep on the bottom of the mold, *P*, Fig. 2, and supports the weight of the core 4 inches off the bottom and also prevents it from shifting from its central position when the pressure of molten iron comes under it. The piece of shafting is removed with the rest of the core during the process of cleaning the casting and later, when the casting has reached the machine shop, a plug is screwed in the hole. The core is prevented from rising by two short pieces of rails, *R*, Fig. 2, resting on the cope and secured to the bottom of the mold by turnbuckles and hooks, *H*, Fig. 2.

The present foundry building is a substantial brick and steel structure 90 x 200 feet divided into three bays. The center bay is 40 feet wide and is spanned by two electric and one handpower traveling cranes. The 10-ton handpower crane built by the Northern Engineering Works, Detroit, was the first installed and served until the volume of work outgrew its capabilities. It now is kept at one end of the shop where the roll pit is located and is used only when one of the other cranes is not available. There is one 10-ton electric traveling crane with a 5-ton auxiliary hoist built by the Northern Engineering Works, Detroit, and one 15-ton crane also having a five-ton auxiliary hoist built by the Pawling & Harnischfeger Co., Milwaukee. The entire center bay with the exception of a 20-foot space at each end used for cleaning the large castings is devoted to molding a miscellaneous line of castings, the majority of which form parts of the various machines and appliances used in the rubber factories. Considerable outside work also is handled including among other castings, frames for steam hammers.

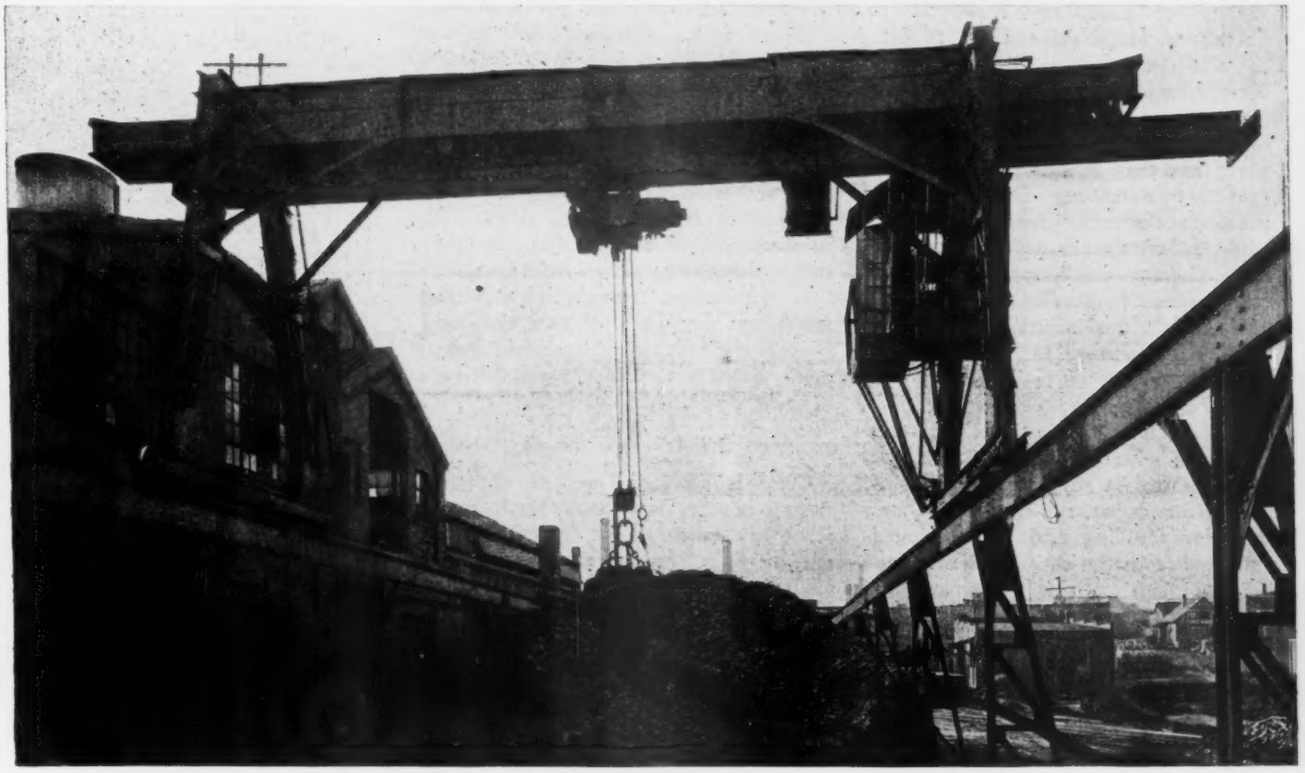


FIG. 7—A MODIFIED TYPE OF GANTRY CRANE WHICH LIFTS THE IRON FROM THE FOUNDRY YARD AND DROPS IT ON THE CHARGING FLOOR OF THE CUPOLA THROUGH THE OPEN DOORWAY SHOWN AT THE LEFT

The west bay of the shop is 30 feet wide. One end for a distance of 30 feet is devoted to bench and snap flask work; a number of benches and other necessary appliances being provided for that purpose. A space of about 50 feet at the opposite end of this bay is devoted to molding odd sizes and short orders of cores for tire molds. The remaining space in this bay is equipped in a special manner for the production of tire molds in quantity.

A general view of the floor taken at 11 a. m. is shown in Fig. 1. A plain jar ram machine made by the Herman Pneumatic Machine Co.,

Pittsburgh, is located at one end of the floor and is used for making the drags while a similar machine situated at the other end of the floor is utilized for producing the copes. The flasks are laid down in four rows and the runners built so that two gangways only are required.

This bay is provided with a crane runway for the entire length and is spanned by two 5-ton electric traveling cranes, one built by the Northern Engineering Works, Detroit, and the other by Pawling & Harnischfeger, Milwaukee.

Miscellany in East Bay

The east bay is devoted to a variety of uses. A space at the north end is partitioned off to serve as a toilet, wash and locker room for the employes and is equipped with all the necessary facilities including hot and cold water. The core room occupies the greater part of the east bay extending from the wash room to the core ovens. It is not equipped with a crane, therefore, the large, heavy cores for steam hammer frames, hydraulic rams, etc., are made on the molding floor in the center bay adjacent to the core room. A large basement extends under the greater part of the core room floor. It is divided into several compartments and is used for a sand storage. There is a round manhole in the floor over each sand bin. The new sand for molding and coremaking is unloaded from the cars on the railroad siding outside onto wheelbarrows and dumped through the manholes into the bins in the basement. A stairway leads down from one side of the core room floor to a gangway which extends in front of all the basement bins.

When a quantity of new sand is needed a man goes down into the bin holding the required grade of sand and with a shovel pitches a sufficient quantity up through the manhole onto the floor. Round iron cover plates are provided for the holes when they are not in use. It is claimed that this method of storing the sand keeps it in perfect condition. The state of the weather has absolutely no effect on it—a circumstance which will be appreciated by foundrymen who have to thaw out their sand in the winter before it can be used or who have seen their sand piles turn to dust in the summer time. An even temperature is maintained in the basement throughout the year and the sand is always cool and damp.

The remainder of the bay is occupied by the core ovens, blower room, cupolas, tumbling barrels and sand-blast installation. A gas fired swinging drawer type oven built by the Monarch Engineering & Mfg. Co., Baltimore, is used for small cores and hurry up jobs. It frequently has been possible with the aid of this oven to make and dry a batch of ring cores in an hour. Each of the two large ovens is 7 x 12 x 28 feet and is fired at present with coke. In addition to long cars equipped with standards and cross rails which enable them to carry four deck loads, the sides of the ovens are provided with racks and shelves upon which an immense quantity of cores are dried every night.

The blower room is on the ground floor adjacent to the cupolas. In it are installed two P. H. & F. M. Roots blowers. The smaller one has not been used since a new and larger cupola was set up. It still is left fully equipped and connected and is held in reserve together with the smaller cupola. The large positive pressure blower is capable of delivering 8000 cubic feet of air a minute and is driven by a 60-horsepower motor made by the Allis-Chalmers Co., Milwaukee. It supplies the blast for a cupola lined to 60 inches and made by the Whiting Foundry Equipment Co., Harvey, Ill. About 30 tons of iron is melted every day.

Delivering Materials

Coke is delivered to the charging floor by an elevator, but the pig iron and scrap are taken direct from the storage piles in the foundry yard by a magnet suspended from a gantry crane and dropped on the charging floor within a few feet of the charging door. The main bridge of the crane travels on a runway which parallels the building; but the auxiliary bridge which is formed of a long 24-inch I-beam has a lateral movement which enables the operator to extend it 10 feet past the end of the upright framework. The trolley carrying the magnet travels on the lower flanges of the I-beam and is controlled independently. This arrangement makes a flexible unit and reduces to a minimum what is generally considered the hardest and most difficult of foundry operations. This crane also carries the coke from the cars to the storage pile by a large bucket provided with a swinging door on the bottom which is tripped by a rope in the hands of a man on the ground. When necessary, the crane is used to operate a drop ball for breaking large pieces of scrap.

For the general run of work the charges of pig and scrap are in the proportion of 40 and 60. They weigh 4000 pounds each with 500 pounds of coke between.

Instructions Sent Out in Bulletin Form

The Foundry Equipment Manufacturers' association organized about a year ago to promote and further the interests of its members by impressing upon foundrymen generally the advantages to be derived from the use of efficient foundry equipment, proposes now to broaden the scope of its activities by conducting a campaign of education on the proper care, maintenance and operation of such equipment after it has been installed.

The members of this association, with their experience covering conditions and problems in all classes of foundries, have been in a favorable position to accumulate facts and data. They now propose to embody this information in a series of monthly bulletins, to be issued during the present year. These publications will be sent directly to the executives, superintendents and foremen of all foundries in the United States and Canada. That they may receive the attention of the men interested, they will be mailed to the home addresses of the plant executives. An adjustable, stiff, cardboard cover will be sent with the first of the series so that the bulletins may be filed as they are received and thus be available for reference. The cover will be of convenient pocket size. Only one individual phase of the problem connected with each piece of foundry equipment will be considered in each of these bulletins. It is stated that they will be written in a concise, practical manner and will contain live operating data on machinery and its care.

The members of the association follow: American Clay Machinery Co., Bucyrus, O.; American Foundry Equipment Co., New York; American Molding Machine Co., Terre Haute, Ind.; Arcade Mfg. Co., Freeport, Ill.; Berkshire Mfg. Co., Cleveland; Beryk Co., Cleveland; Blystone Mfg. Co., Cambridge Springs, Pa.; Buch Foundry Equipment Co., York, Pa.; Cleveland-Osborn Mfg. Co., Cleveland; Federal Foundry Supply Co., Cleveland; Foundry Equipment Co., Cleveland; Grimes Molding Machine Co., Detroit; Hanna Engineering Works, Chicago; H. M. Lane Co., Detroit; McLain-Carter Furnace Co., Milwaukee; National Engineering Co., Chicago; S. Obermayer Co., Chicago; Pangborn Corporation, Hagerstown, Md.; J. W. Paxon Co., Philadelphia; Henry E. Pridmore Co., Chicago; P. H. & F. M. Roots Co., Connersville, Ind.; U. S. Molding Machine Co., Cleveland; Wadsworth Core Machine & Equipment Co., Akron, O.; Whiting Foundry Equipment Co., Harvey, Ill.; E. J. Woodison Co, Detroit; Young Bros. Co., Detroit.

Checking Mistakes in Stock Records

Cupola Charging Sheets are Made Up Each Day Showing the Amounts of Different Materials Used—Entries of Pig Iron Charges are Made On Separate Cards for Each Carload

BY ROBERT STOTT

IN THE FOUNDRY of Dec. 15 there was an article describing a simple system for keeping perpetual inventory. While this article was interesting as far as it went, we think that the author could have profitably told how the records are kept to determine the amount of iron which has been used. This is an important detail of any stockkeeping system, because if an adequate check is not kept to catch any mistakes in weighing, the inventory, on which reliance is placed, may in time be far off from the actual amount of stock on hand. Therefore, details of a system followed by a firm which employs a chemist may be of interest. In this case the chemist keeps most of the records, but the plan could be easily modified to adapt it to a foundry which does not have a chemist.

When iron is received at the scale house a notice of its weight is sent to the chemist, who also receives a notice from the supplier giving the grade and the analysis of the iron. These are put down on a 3 x 5-inch card, one of which is shown in Fig. 1. Later check determinations of sulphur and silicon are made. Should these not agree reasonably close with the analysis furnished by the shipper, a second sample is taken. If this sample shows enough variation to warrant asking for a rebate the firm who supplied the iron is notified. Sometimes this firm will allow the rebate without question, at other times it will ask for a part of the sample which shows the discrepancy, or it may send a representative to take another sample in conjunction with the foundry chemist. This check sampling is made possible by the fact that every car of iron is kept separate from all other iron. Sometimes it is stacked on a pile by laborers and at other times it is allowed to lay as thrown off the car, depending whether it is to be used promptly or not. By holding a few cars for emergencies and using the iron as it is received a lot of labor can be saved.

The chemist makes out the charge each day in triplicate on a standard 8 x 10-inch form made up in pads. One of these is sent to the man in charge of getting the stock to the cupola, another goes to the foundry foreman and the third is retained in the laboratory. As can be seen in Fig. 3 this charging sheet tells the foreman of the stock laborers what iron, scrap and coke to put on the charging platform. This man also oversees the charging of the cupola and the charging sheet tells him how many charges to put in and the amount of flux for each charge.

The number of charges is determined by the chemist after he receives a re-

Pig Iron — Car No. Pa. 167832
From John Jones Co. — Rec'd 7/8/19
Grade #3 — Weight 103785

	Sil.	Sul.	Phos.	Man.
Furnace Analysis	1.64	.040	.617	.63
Check Analysis	1.70	.046		
Remarks				

On Hand	103785		68785		31685
8-11	2800	8-18	5600	8-25	6300
12	7000	19	6300	26	7000
13	6300	20	6300	27	7000
14	6300	21	7000	28	6300
15	7000	22	6300	29	4700
16	5600	23	5600	30	Out
Used	35000		37100		31300
Left	68785		31685		385

FIG. 1—DAILY RECORDS OF INDIVIDUAL CARS OF PIG IRON ARE KEPT ON THE BACK OF CARDS—THE FRONT OF THE CARD SHOWN IN THE UPPER HALF CONTAINS THE ANALYSIS OF THE IRON

Report of Cupola Consumption—Iron Foundry
For....Week.....Ending....Aug. 31, 1919...

Grade	Weight Charged Lb.
#2	106300
#3	34700
385 Pounds #3 Added For Car Pa. 167832	
Total Pig Iron	141000
Car Wheels	5300
Cast Iron Scrap	42300
Steel Scrap	6800
Total Metal	195400
Coke 24300 Lb.	

Signed
Robert Young Chemist
Date Aug. 18, 1919

FIG. 2—WEEKLY REPORTS ARE MADE FROM THE CUPOLA CHARGING SHEET

port, about 10:30 in the morning, from a clerk who ascertains the amount of iron each subforeman will require. Should the general foreman later find that less or more iron is needed he gives the cupola tender instructions without consulting the chemist. The instructions may change the number of charges but not the mixture. Any change in the original program is marked on the charging sheet by the foreman of stock he calculates the amounts of the various grades of pig iron, steel and cast-iron scrap, coke and limestone used, and places the figures on the backs of the proper cards as illustrated in Fig. 1. At the beginning of the week the totals for the previous week are sent to a clerk in the purchasing department on a form shown in Fig. 2. This clerk keeps a record of the amounts of pig iron on hand and the price, by grade The way any discrepancies in weight are checked and corrected may be seen by following the course taken by the car of pig iron recorded on the card illustrated in Fig. 1. The weight of pig iron received is placed on the back of this card, at the top of the first column in the line marked: *On hand.* The first iron from this car was used on Aug. 11, as shown by the date. The fact that only about half the amount was

CUPOLA CHARGING REPORT

Cupola No. ..... **Date** ..... **191** .....

Contract									Heat Started	B.P.	oz.	
Grade									Heat Stopped	B.P.	oz.	
Car No									Bottom Dropped			
Charge	COKE	PIG IRON						SPRUES	CAST SCRAP	STEEL SCRAP	CAR WHEELS	FLUX
1												
2												
3												
4												
5												
19												
20												
21												
22												
23												
24												
Totals												

Element	SIL.	SUL.	PHOS.	MN.	T. C.	C. C.	
Computed Comp.							Transverse
Analysis of Output							Tensile
							Shrinkage

Iron Melted ..... Lb. per Lb. Coke APPROVED .....

FIG. 3—THE CUPOLA CHARGING REPORT IS MADE OUT BY THE CHEMIST—IT INFORMS THE FOUNDRY WHAT IRON TO USE AND SERVES AS A BASIS FOR THE WEEKLY REPORT TO THE PURCHASING DEPARTMENT

laborers and the sheet is returned to the chemist who keeps it on file.

Coke is handled in a similar way, every car load being tested for sulphur and ash. The scrap and sprue delivered to the scrap yard from the foundry, is weighed and the amount reported to the chemist who keeps a record of it on a card similar to the pig iron card, Fig. 1. Foreign scrap is kept on separate cards, each car load having its own card.

When the chemist receives the cupola charging sheet back from the foundry numbers only. He pays no attention to which cars have been used. He also receives a notice of all receipts from the man at the scale house. From these notices he checks the weight for which the company is billed and keeps a record of the amount due on orders. When the purchasing agent decides that it is a good time to order more iron, he consults with the chemist as to the grade to be ordered. However, the time and the amount is finally determined by the purchasing agent according to future requirements and current market conditions. taken that day, as on subsequent full days, would indicate that a new mixture was started about the middle of the heat. The amount used the first week was added in the first column and the amount left, after subtracting the quantity used from the weight received, was placed at the bottom of the first column and at the top of the second. The second and the third week were figured in a similar way, but on Friday of the third week, the iron was reported all used while the record shows that there

(Concluded on page 69)

Conveyors Speed Foundry's Work

Every Half Minute a Mold on Each of Two Conveyors is Cast—A Sand Conveyor Located in the Middle Supplies All the Molders With Sand and Carries the Used Materials Back to the Mixer

BY H. E. DILLER

ECONOMIC laws control business conditions and eventually right every abnormal state in industry. At present an insatiable demand for commodities is met by labor shortage in every activity. These two opposing states rapidly are being reconciled by labor-saving devices which give large production with a minimum of labor. Molding machines for many years have been employed in foundries to effect this result and they continually are being improved. Sand handling devices are being used to a greater extent than ever before and help materially in reducing other manual operations. More recently various forms of mold conveyors have found favor as an agency for increasing output and decreasing human effort. All the accumulated wealth of engineering knowledge gained from years of study and the practical adaptation of these different labor-saving methods in foundries making a great variety of castings, light, medium and heavy, is available to the company designing a new foundry. Such a firm is not handicapped by an old building to which conveying machinery must be accommodated at an extra expense for reinforcements and re-arrangements; nor is it limited by the size and contour of a structure already erected. A new enterprise has a clear field to pick the method and the equipment best suited for its work and design the building to house its machinery to the best advantage.

For these reasons a greater number of inducements are held out to the firm building a new foundry, to equip it with a full complement of labor-saving devices. An example of such an installation is found in the new foundry of the Kelsey Wheel Co., Detroit. Until recently this company had no foundry but secured all its castings from outside sources. It has lately erected a foundry building designed to give the best lighting, ventilating and working conditions. This building is equipped with mold and sand conveying systems installed by the Link-Belt Co., Chicago. Two mold conveyors, each having parallel sides connected at the ends with a semicircular section are situated on both sides of a conveyor which carries the used sand to a mixer and back to hoppers suspended over the molding floors. The molding machines are arranged in two rows under the sand hoppers. One of these rows of hoppers may be seen in Fig. 6. The other row is parallel to it on the opposite side of the conveyor. A general idea of the complete system may be obtained from the drawings of the plans and elevations of the sand-handling equipment and one of the conveyors which are shown in Fig. 3. One mold conveyor serves for molds for front and rear hubs for a tractor. A view of one side of this conveyor may be seen in Fig. 9. The molds are placed on the conveyor on the side opposite to the one shown. The small molds are for the front wheel hubs and large molds are for the rear wheel hubs. All molds are poured at the end shown in the foreground

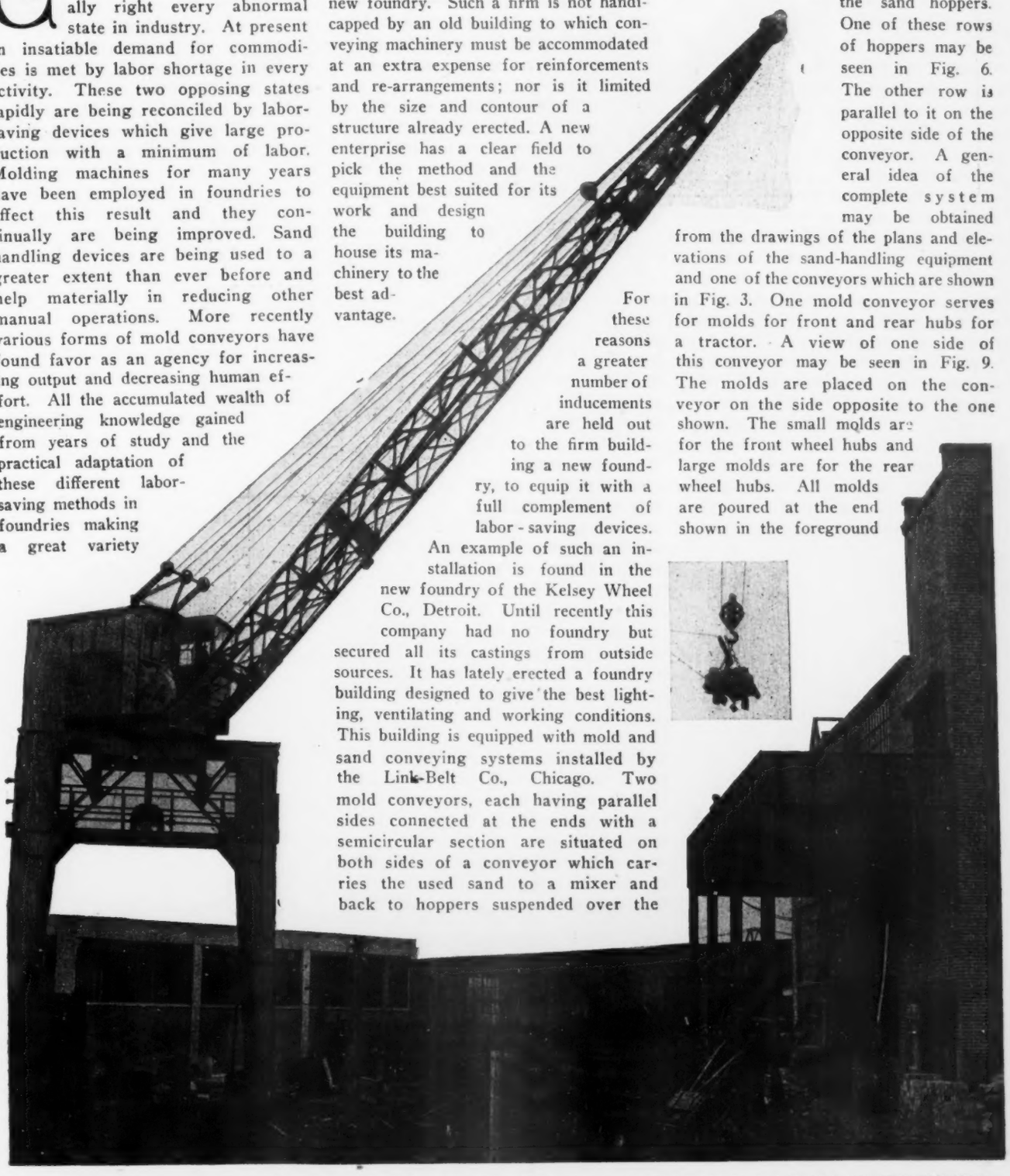


FIG. 1—THIS GANTRY-TYPE JIB CRANE CARRIES PIG IRON, SCRAP AND COKE FROM THE STOCK PILES TO THE CUPOLA CHARGING PLATFORM

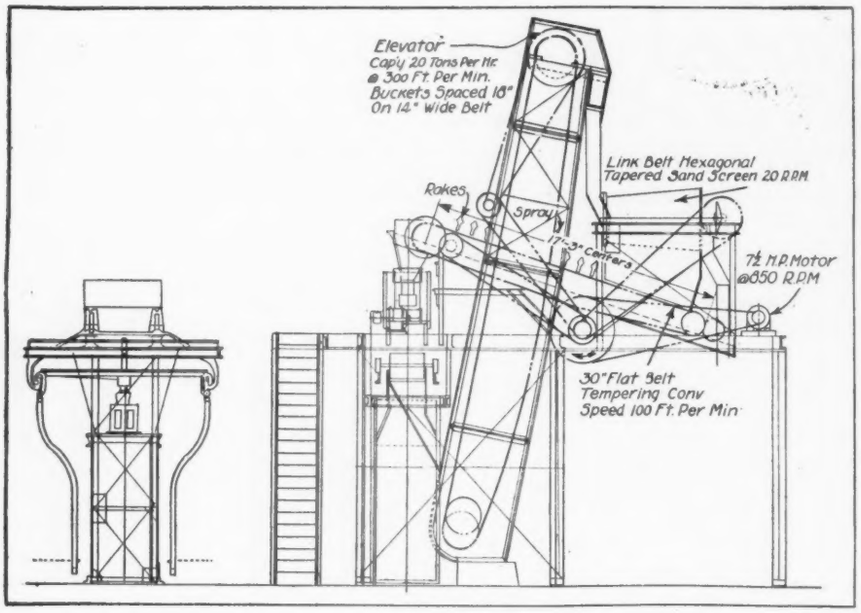


FIG. 2—TO THE LEFT, END ELEVATION OF ONE OF THE MOLD CONVEYORS—TO THE RIGHT, ELEVATION OF THE SAND ELEVATOR, MIXER AND REVIVIFIER

and usually before they reach the point at which pouring is taking place in the illustration. The conveyor has 30 arms made from 3-inch pipe with extra heavy walls. Each arm is fitted with a specially shaped tray for holding the mold, and another flat stand for carrying the cores and the spokes until they are placed in the mold.

The conveyor travels 10 feet per minute and as the arms are 5 feet apart one arm passes any given point every half minute. This means that a mold passes the pouring floor every half minute. There are 30 arms on the conveyor so, at the rate of one every half minute, a complete revolution is made in 15 minutes, or four revolutions are completed every hour. This means that 120 molds are cast in one hour. After the mold is poured at one end of the conveyor it is allowed to cool for approximately seven minutes until it reaches the other end of the conveyor. During this

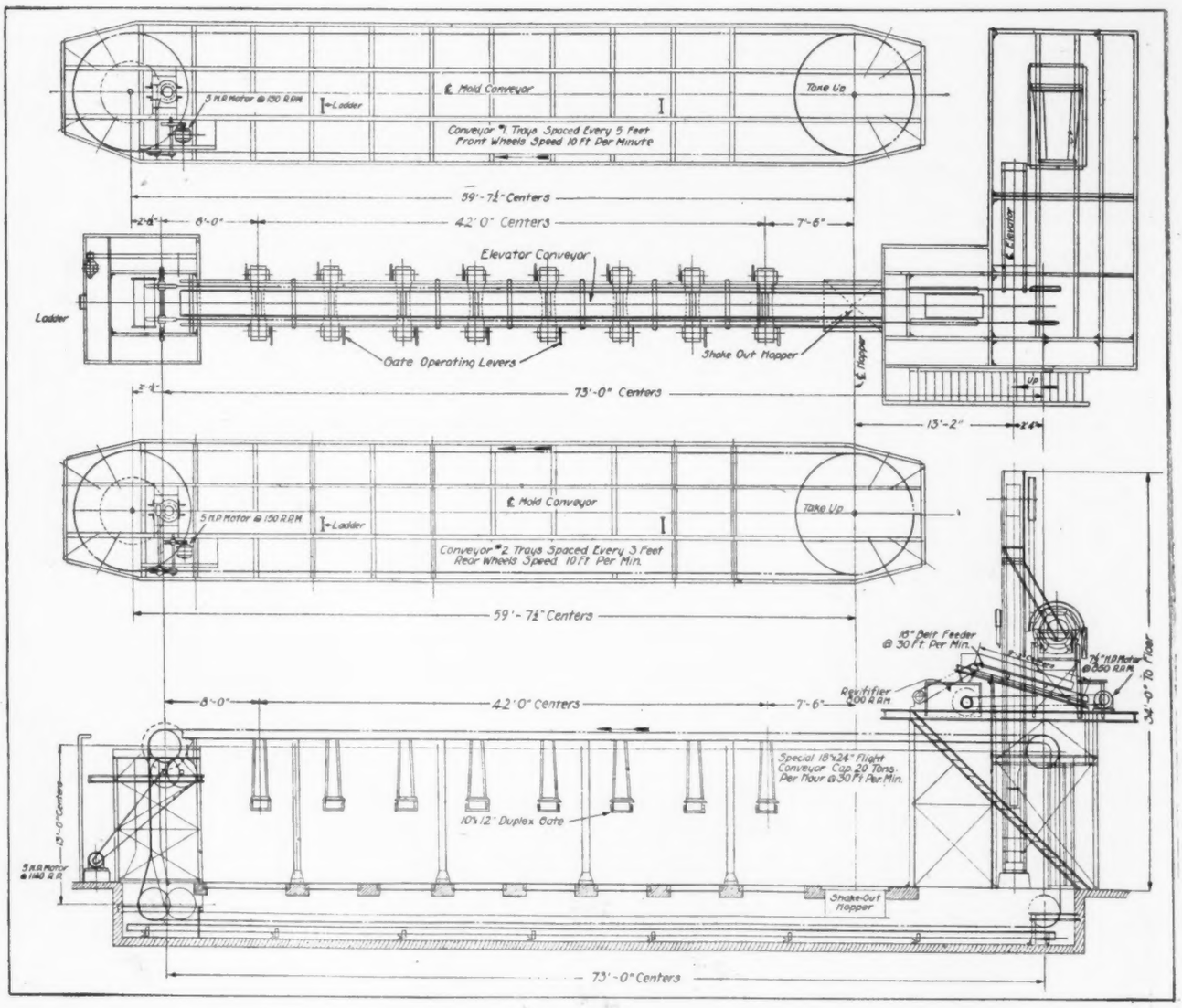


FIG. 3—ABOVE IS THE GENERAL PLAN SHOWING THE SAND CONVEYOR BETWEEN THE TWO MOLD CONVEYORS—THE LOWER VIEW IS A SIDE ELEVATION OF THE SAND CONVEYOR AND MIXING SYSTEM

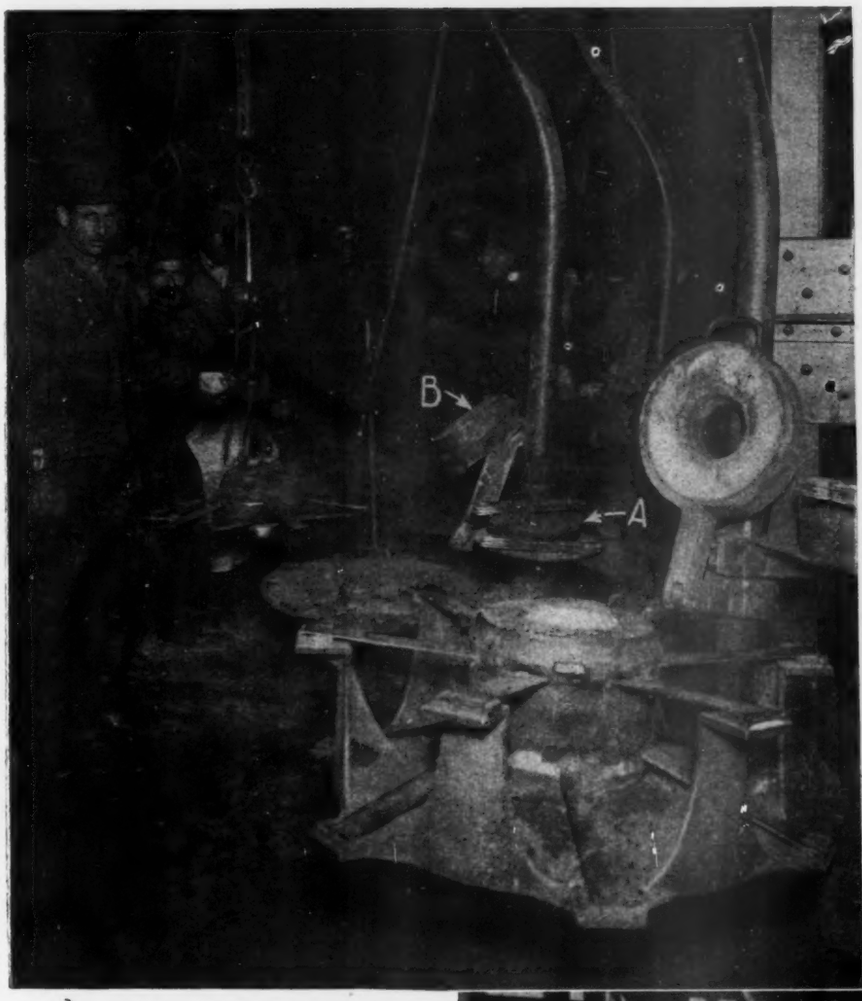


FIG. 4—AFTER THE COPE IS REMOVED CASTINGS ARE LIFTED FROM THE CONVEYOR WITH A GRAB HOOK ON A BLOCK AND TACKLE RIG

time a core is placed on each of the flat auxiliary trays. These cores are carried from the core room upon the stand on which they are baked. The racks are carried on electric trunks furnished by the Baker R & L Co., Cleveland. Spokes also are brought to the foundry floor on electric trucks furnished by the same company. The spokes are strips cut from flat steel bars. A hole is bored through the center of the end which is cast in the hub. This end is also tinned as far as it extends into the hub. The spokes do not thoroughly weld to the iron but are held securely by the iron which fills the hole bored in the spoke ends. The core and spokes in their position on the auxiliary tray may be seen at *A* in Figs. 4 and 5.

The first operation in the production cycle is to make the drags for the front wheel. These are made in duplicate on a squeezer by one molder. The cope for the front wheel also is made in duplicate by one molder. Both the copes and drags for the rear wheel molds are made singly, two molders operating two squeezers being required for each part. The drag is placed on the conveyor by a laborer. Another workman sets the lower line of spokes. The next man sets the core and then the upper layer of spokes are put in place. A laborer sets the cope and the next man closes the mold, filling all joints with molding sand to prevent runouts. The weight connected to the conveyor arm is then lowered and the mold is ready for pouring. As may be seen from Fig. 4, the trays which carry the molds are specially designed to hold the spokes in their proper positions in the mold. One of the weights which has been raised from the mold after casting, also is shown in the same illustration. These weights are solid cast iron and heavy enough to hold down the cope without being clamped. They are hinged to the arm of the carrier and need only be lowered and raised to perform their function.

The molds are poured as they pass the cupola. This operation is shown

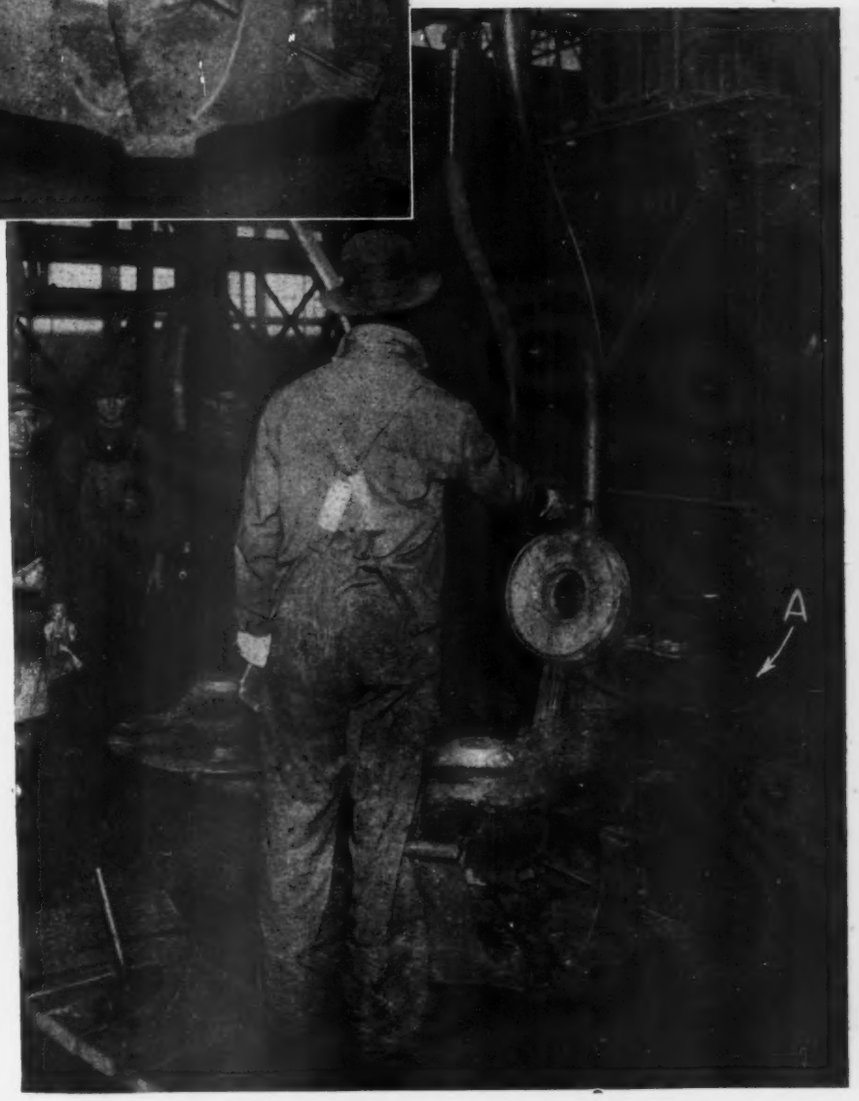


FIG. 5—THE FIRST OPERATION AFTER POURING IS TO LIFT THE WEIGHT OFF THE MOLD

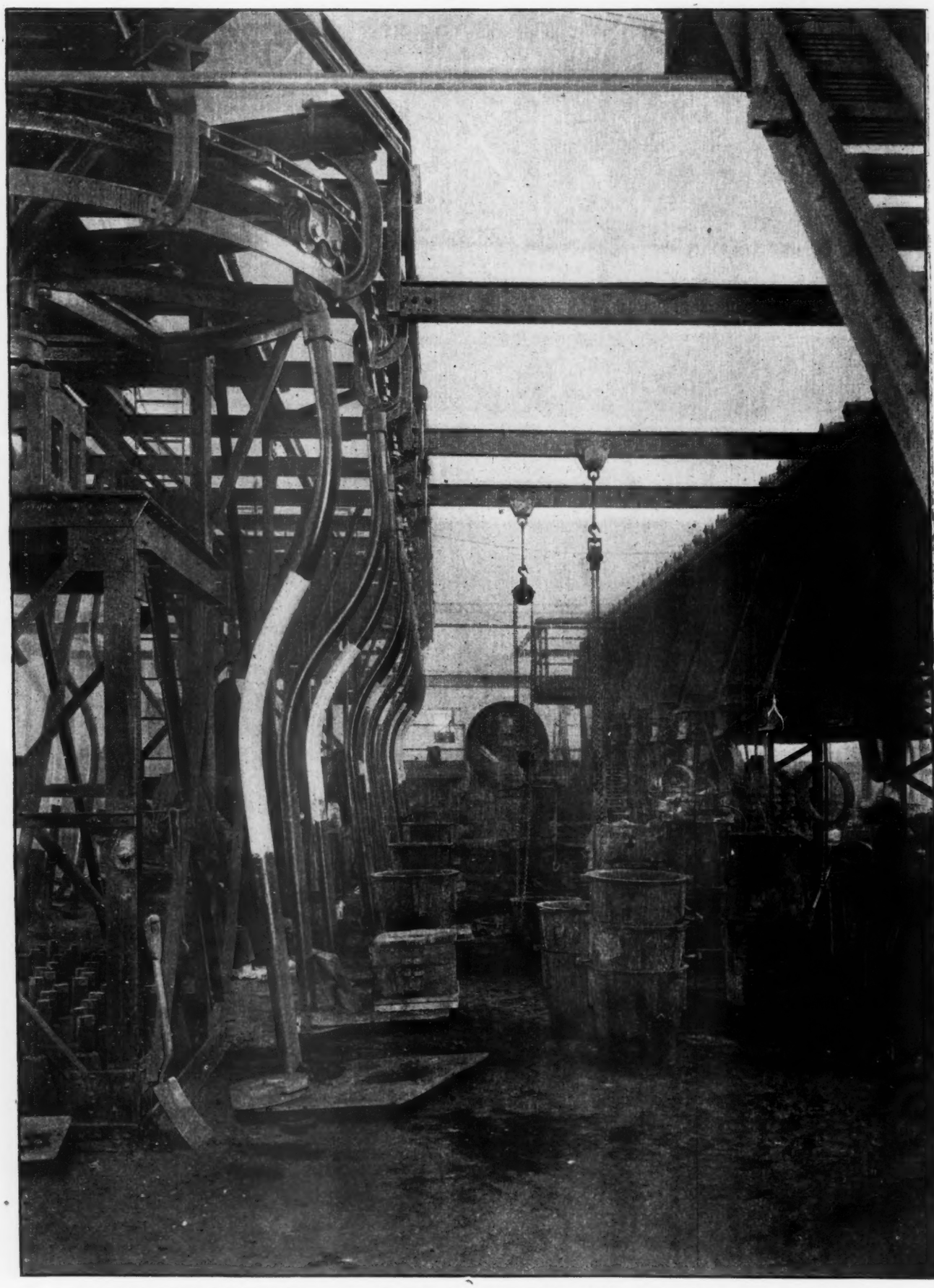


FIG. 6—VIEW OF THE SECOND MOLD CONVEYOR TO THE LEFT WITH THE ROW OF SAND HOPPERS TO THE RIGHT ABOVE THE MOLDING MACHINES—EACH SECOND ARM OF THE MOLD CONVEYOR IS PAINTED WHITE AS AN INDICATION THAT IT IS FOR THE MOLD OF A SPECIAL CASTING—HOISTS FOR CARRYING THE MOLDS FROM THE MACHINES TO THE CONVEYOR ARE SHOWN IN THE CENTER

in Fig. 7. The mixing ladle may be seen directly behind the man standing to the right in the picture.

At present the pouring is done from bull ladles but it is planned to provide a 400-pound ladle on an I-beam trolley for pouring castings. In addition to the men required for pouring, one man is employed at each pouring station skimming the iron as it flows from the ladle. The iron flows into a basin formed by the weight and through a gate into the cope. In the rear-wheel mold this gate is formed by a center core 6 inches in diameter containing six pencil gates. This core also serves to center the print of the main core of the mold which is placed between the drag and the cope. The gate for the front wheel mold is cut in the cope. The metal falls on the print of the center core and is distributed from there through three runners. These two methods of top gating have been adopted because they simplify molding conditions and give satisfactory castings. The hot metal as it runs into the mold forms a pool in the basin made by the weight. This gradually eats away a portion of the weight and makes occasional replacement necessary. For this reason the weights are designed as simply as possible and the expense of replacing them is kept at a minimum. Their life is prolonged by washing them with graphite every night, and filling any cracks in them with graphite paste.

As has been stated approximately seven minutes elapse from the time of pouring until the next operation takes place. When each successive mold reaches the end of the conveyor opposite the pouring station a man standing on a small wooden platform hits the weight with a hammer and then raises it on its hinge and allows it to fall back and rest against the arm of the conveyor as shown in Fig. 5. The mold passes along to the next man who lifts off the cope, shakes out the molding sand upon a conveyor and places the flask back on the conveyor. One of these flasks, all of which are made of cast iron, is seen being carried by the conveyor to the molder at *B* in Fig. 4. While the frames for the front wheel may be placed directly on the conveyor after being lifted from the mold, the frames for the rear wheel molds must first be cooled by plunging into water. This difference is accounted for by the fact that the rear wheel hub is considerably larger than the hub for the front wheel and makes its flask hotter.

The next operation is to lift off the casting. This is done by two men with a snatch block operating on a monorail. The casting is carried over a grating above the conveyor which carries the used molding sand, and any adhering molding sand is knocked off upon the conveyor. The casting then is taken to the cleaning room where the core sand is knocked into another conveyor. After the casting is lifted from the mold conveyor, the drag is taken off and the sand is dumped through the grating upon the sand conveyor. Another workman cleans the sand from the tray and all is ready for another mold to be set in place. The sand conveying systems will be explained more fully later in this article.

At present the completed cleaning system is not installed. When this is in operation the castings will be taken by a conveyor moving continuously through a sandblast cabinet being hung with chains to trolleys on an I-beam. This cabinet will be supplied by the Pangborn Corp., Hagerstown, Md.

The second mold-conveying system is similar in most respects to the one just described. A section of it is shown in Fig. 6. From this illustration it may be noted that the carriers are equipped somewhat differently from those on the first conveyor. These carriers have flat trays and will carry any ordinary mold. The arm of every second carrier is painted white to indicate that it is reserved for a special job. The number of trays and the speed of revolution is just the same as for the first conveyor—30 trays, 5 feet apart, move at the rate of 10 feet per minute, thus making a complete rev-

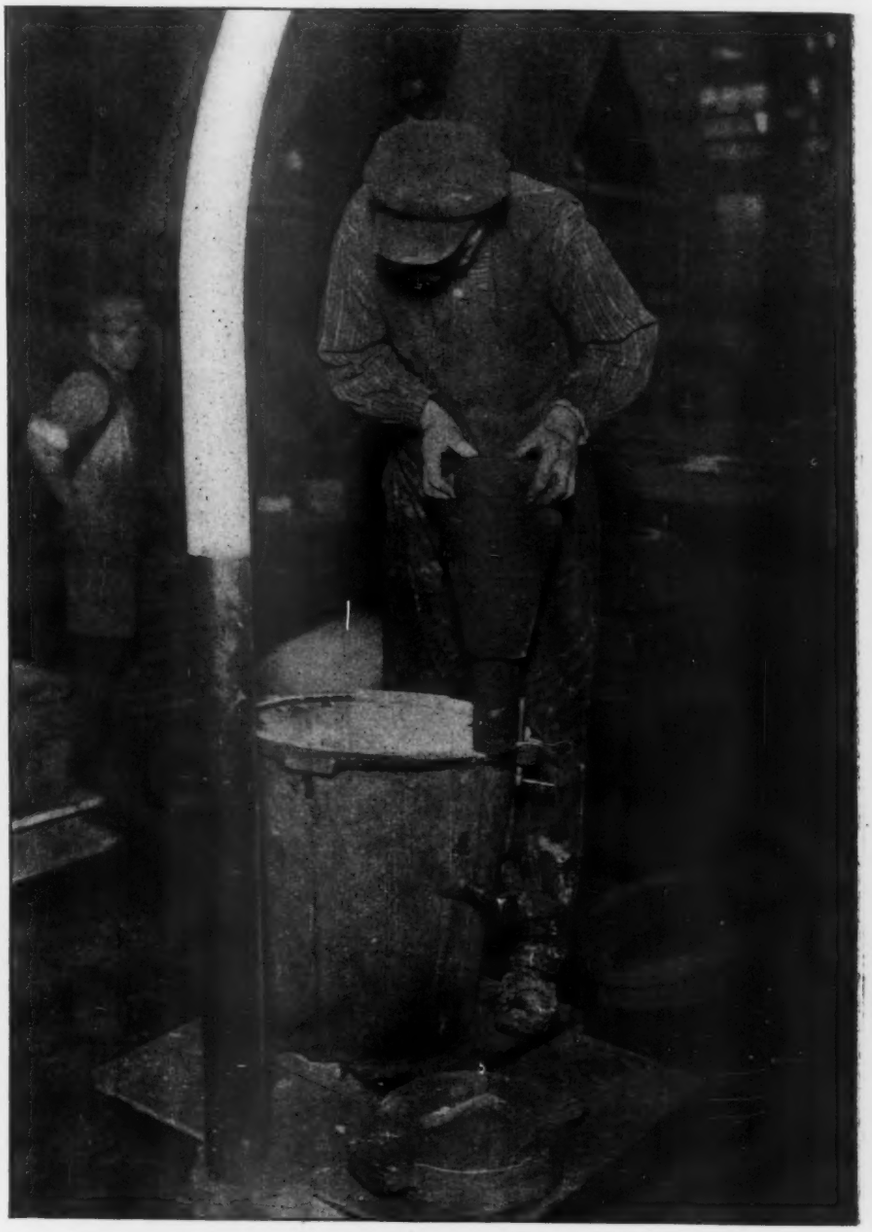


FIG. 7—THE CENTER CORE OF THE REAR AXLE HOUSING MOLD IS SET WHILE THE CONVEYOR IS IN MOTION

FIG. 8—METAL IS POURED FROM HAND LADLES AT PRESENT—THESE WILL BE DISPLACED BY A 400-POUND LADLE CARRIED ON AN I-BEAM WHICH WILL CONVEY THE QUANTITY REQUIRED FROM THE MIXER WHERE THE CUPOLAS ARE TAPPED TO THE POURING END OF THE CONVEYORS

FIG. 9—THIS CONVEYOR CARRIES THE MOLDS FOR TRACTOR WHEEL HUBS, ONLY ONE CLASS OF MOLDS BEING HANDLED—THE POURING GANG IS SHOWN AT WORK—NOTE THE LIGHTING FROM THE AMPLE GLASS SASH IN THE WALLS

olution every quarter hour in the day.

Fig. 6 shows the details of the second mold conveyor and indicates its relationship to the molding machines and sand conveyor. Looking at the carrier to the front, the two wheels which hold the arm may be seen on the track. Above them is the link-belt which moves the arms. A portion of the wheel around which this belt turns may also be distinguished. The top of the sand conveyor may be seen to the right with the sand hoppers extending down from it. At the upper right-hand corner is shown the steel stairs which lead to the platform on which is located the sand treating machinery.

All jobs which come to the foundry other than the hub castings are cared for on this conveyor. At present a casting for the rear axle housing of an automobile is being made on every second carrier. On the other carriers two different castings are being made. The drag mold for the axle housing is made on two jar-ram machines supplied by the Cleveland-Osborn Mfg. Co., Cleveland. They are carried from the molding machine to the conveyor by chain hoists running on I-beams one of which is over each of the two machines. These hoists with the I-beams may be seen in the center of Fig. 6. After the mold is placed on the conveyor the center core is set without stopping the conveyor. The core-setter stands on the tray as shown in Fig. 7 to place the core. The print of the core fits into a core gate in the cope. This core has six pencil gates and is similar to the one used for the large hub casting on the first conveyor. The metal flows into this mold over the center core as in the hub castings described.

The mechanical system for handling the molding sand is located between the two mold conveyors. As has been said the molds are shaken out over a grating in the floor. The sand falls through into a hopper underneath, and from here is delivered by a conveyor to the lower run of an elevator conveyor which raises it to the second floor of the building and delivers it to a revolving screen. After passing through the screen the sand is delivered to an inclined tempering belt where the necessary amount of water for tempering is added. This belt delivers the sand to a short inclined belt feeder which in turn delivers the sand to a revivefier.

After the sand passes through the revivefier it falls upon the upper run of the main sand conveyor which carries the sand through the foundry to the molding stations. This conveyor scrapes the sand along a steel trough. At intervals in the trough are rectangular holes which lead into bifurcated hoppers over the molding floors. In this way all the hoppers are kept filled with sand. The lower ends of these hoppers are closed with 12-inch hand-operated gates. Sand carried along the conveyor falls into the first hopper until it is filled. Then excess sand is taken to the next hopper and so on until all hoppers are filled. After all hoppers are filled the excess sand falls through an overflow spout at the extreme end of the conveyor. This directs the falling sand upon the lower run of the main conveyor which carries it back to the elevator and it again goes through the screen. In this way excess sand is kept continually in motion through the system. Gratings are located in the floor the entire length of the lower run of the main conveyor so that castings may be shaken out at any place along the floor.

Core sand is handled is a separate conveying system. It is dumped from the railroad cars into four brick and concrete hoppers. These are under cover and heated to prevent freezing. Each bin has a capacity for 25 carloads of sand. From the bins it is carried by a bucket conveyor to a sand mixer in the core room. This mixer was built by the Standard Sand & Machine Co., Cleveland. The sand is screened after being mixed and then carried to the coremakers' benches by a grab bucket hung on a monorail. Used core sand is reclaimed by passing it through a set of three rolls designed by the Kelsey company. The three rolls are arranged somewhat in the manner followed in steel rolling mills, with the difference that the upper and lower rolls are in the same vertical plane, while the middle roll is offset. Sand is fed between the upper and middle rolls, passes over the middle roll and between the middle and lower roll. The entrance space between the rolls is greater than that between the middle and lower rolls.

The core sand mixture consists of 50 per cent new sand and 50 per cent reclaimed sand. Two different mixtures are used. In the one oil is employed as a binder, and in the other glutrin forms the bond. The oil cores are adapted for the smaller work. A few of the cores are made on benches and the remainder are made on six roll-over machines built by Henry E. Pridmore, Chicago. One of these machines is shown in Fig. 10. In front of the core benches next to the drying ovens are two blackboards. The number of cores made each day of the week are recorded on the board to the left. The number of the principle cores are tabulated in a separate column. The time that a charge is placed in the oven as well as the time each charge is withdrawn is recorded on the board at the right. The coremakers at this bench are making the center core for rear axle housings. One notable feature of the core room is that every coremaker is supplied with an air-hose attachment. Two of these may be noted in both Figs. 10 and 11. To the extreme left of each of these illustrations may be seen portions of the racks on which cores are dried. These racks are carried about the core room on lift trucks supplied by the Barrett-Cravens Co., Chicago, and on electric trucks as described.

FIG. 10—EVERY COREMAKER IS SUPPLIED WITH A LINE OF COMPRESSED AIR—NOTE THE AIR HOSE HELD BY THE COREMAKER, AND IN FRONT OF THE WINDOW ABOVE THE OTHER WORKMAN

The cores are dried in four ovens each of which holds four racks. These ovens which were built by Holcroft & Co., Detroit, are heated by gas secured from the city mains. Each oven is equipped with a recording thermometer supplied by the Taylor Instrument Co., Rochester. The cores are taken from the ovens on the racks by electric trucks and carried to the first floor in an elevator.

A gantry-type jib crane which travels back and forth a distance of about 100 feet carries the pig iron and scrap from the stock yard to an elevated platform immediately outside of the cupola charging floor. Although this crane does not travel a great distance its long boom, raising and lowering, and revolving in a circle, enables it to cover a large area of ground. Frequently pig iron is taken from the car in which it was received and delivered direct to the charging platform by the crane. At other times the pig iron is unloaded on the stock pile and later delivered from there to the charging platform. While the pig iron is handled by a magnet, coke is taken to the charging platform by the crane in a grab bucket, shown in the foreground of the illustration.

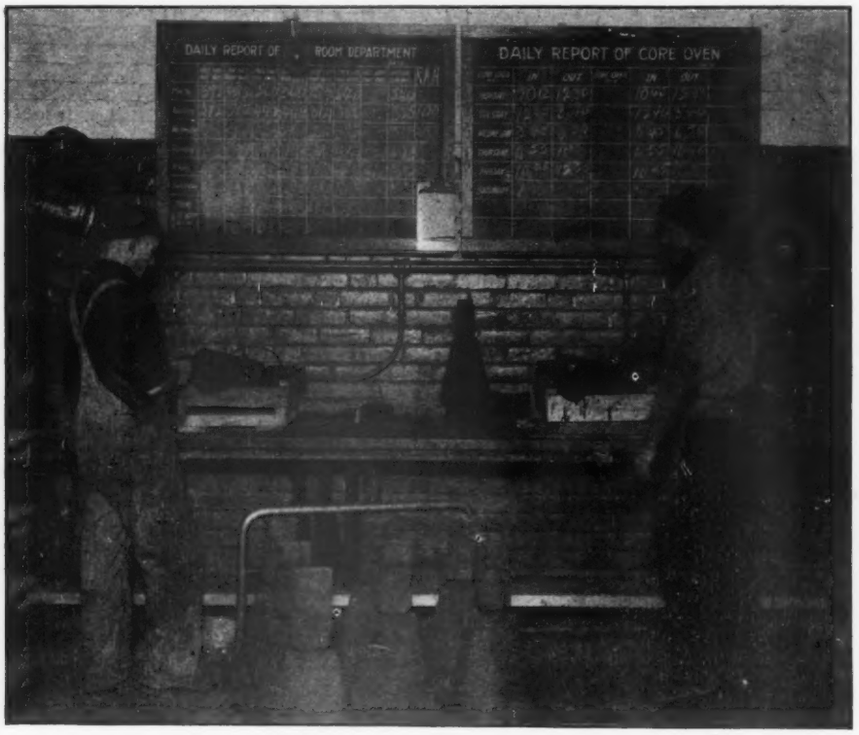


FIG. 11—A RECORD OF THE NUMBER OF CORES MADE AND THE TIME THE CORE OVENS ARE CLOSED AND OPENED IS KEPT ON TWO BLACKBOARDS

Two cupolas made by the Whiting Foundry Equipment Co., Harvey, Ill., have been installed. One of these cupolas is lined to 42 inches diameter and the other to 54 inches. The smaller cupola at present is in use almost exclusively. The charge in this cupola consists of 400 pounds of scrap iron, 600 pounds of No. 2 pig iron and 10 or 20 pounds of ferrosilicon. The latter contains approximately 8 per cent silicon. Between the charges of metal, 160 pounds of coke are used. Scrap iron from the cast of the previous day is put in the first charges with 10 pounds of ferrosilicon. After this is all used, foreign scrap is substituted and the amount of ferrosilicon is increased from 10 to 20 pounds. A record of the amounts charged is kept on a large blackboard hung on the wall of the charging room, so that any person coming into the room at once may see what has been done. Iron from the cupola is caught in a 3000-pound reservoir ladle in order that it may become better mixed before it is poured into the casting ladle.

Scientific Mixing

The chemist has entire charge of mixing and melting the iron and is responsible for its quality. To determine whether the iron is satisfactory a number of intermittent tests are made. The amounts of silicon and sulphur in the iron are found by chemical analysis three times a day. Brinell tests are made frequently to ascertain the hardness of the iron. Transverse tests are made on a 1-inch square bar. This size bar has been found to give the most concordant results.

Temperature is a most important consideration in casting the metal and heat tests are made frequently by noting the length of time required for the pool of iron in the pouring basin of certain castings to set. Pouring is continued through the entire day about 25 tons being melted during the working period. Blast is turned on at 7:50 a. m. and about 8:15 iron is tapped. The air is shut off 15 minutes for lunch and finally for the day shortly after 4 o'clock. The dump from the cupola is cleaned in a water mill built by the W. W. Sly Mfg. Co., Cleveland.

The building has a roof with two monitors. The sides are glass sash from the sill to the roof. These sash were furnished by the David Lupton's Sons Co., Philadelphia. This type of construction has the disadvantage of requiring a large amount of heat to keep the plant interior warm, but it has the great advantage of giving plenty of light in the shop. Fig. 9 illustrates the clear illumination furnished by the wall of glass.

Acids For Pickling

Question—Please advise us the best known method of pickling cast iron.

Answer—The best method to use will depend upon the condition of the castings before cleaning and the purposes for which they are intended. In one method of pickling the castings are placed in a bath of hydrofluoric acid diluted with eight times its bulk of water. The castings may be allowed to remain in the bath any length of time after the sand is all eaten away as the acid does not attack the metal. After the castings are removed from the pickling solution they should be washed thoroughly in clean hot water. One disadvantage of this method of pickling is that the oxide scale is not cleaned from the casting, but there would be little such scale on iron castings and it would not be objectionable on castings for some purposes.

Other methods for pickling require a pickle of hydrochloric acid diluted with three times its bulk of water, or a pickle of sulphuric acid diluted with five times its bulk of water. It is necessary to remove the castings from these solutions as soon as they are cleaned and wash them in hot water, otherwise the acid would continue to eat the iron and cause an undue waste of acid and metal. Castings are sometimes cleaned with hydrofluoric acid to remove the sand and afterwards put in a pickle of either hydrochloric acid or sulphuric acid to remove iron oxide scale.

Training Men For Foundry Duties

Existing Conditions in Foundry Labor Demand a More General Use of Short Time Training Systems for the Apprentice Labor and Unskilled Help Now Available

BY C. C. SCHOEN

DURING the stress of war, the training and dilution service of the United States department of labor discovered that many helpful features of organized training as applied to the production of war materials were equally applicable to peacetime industry. Therefore, immediately after the signing of the armistice this service was reorganized under the name of the United States training service to assist all industries, desiring assistance, to establish methods of training their workers within their shops. Among the industries that requested assistance of this service were machine, tool, textile, shoe, rubber, foundry and others.

With the number of available training experts limited, and a due date of June 30 set for the completion of this work, C. T. Clayton, director of the service, realized that only a fraction of those factories seeking help could be accommodated, and therefore delegated to different committees the task of outlining recommendations applicable to the particular industries most urgently requiring and desiring assistance.

The committee on foundry training confined its activities to the following schedule:

1. Confer with foundry organizations, clubs, owners and managers throughout the country, to ascertain their attitude and opinion.
2. Determine by means of a questionnaire—
   (a) Character and extent of training being carried on at present.
   (b) Reasons for present lack of training.
   (c) Extent to which training is desired.
3. Outline recommendations for the guidance of those instituting foundry training covering apprenticeship training, upgrading and training foremen.

The foundry organizations conferred with were not only interested and enthusiastic, but appointed committees to co-operate. Aside from a small minority (less than 1 per cent) the owners and managers were enthusiastic and pledged their support. About 1 per cent of the 646 foundries investigated have a definite program and less than 1 per cent give technical instruction. Of the 440 foundries replying on the upgrading question, 65 per cent are active in upgrading their help. The chart shown as Fig. 1 illustrates the extent to which training is carried on at present in foundries located in different parts of the country.

Considering the high turn-over prevalent in foundry apprenticeship, which in some cases has been given as high as 150 per cent, it is evident that the number completing their apprenticeship is very small. In general, the following reasons were given for the present lack of apprenticeship training:

Reluctance of young men to engage in foundry work.
Ease with which many young men with limited experience and knowledge can secure employment as journeymen.
The tendency of foundry employes to discourage apprentices.
Inability of foundry owners to master their training problems, etc.

Causes of the reluctance of young men to engage in foundry work have been given as low wages, unsanitary conditions, laborious work, monotonous routine, adverse influence of public schools, the four-year apprenticeship clause, lack of any sound, practical, or definite training program, and lack of proper incentives.

The effect of these causes on foundry apprenticeship, as illustrated by the chart, is the low percentage of apprentices entering this work and the result that few of those who enter complete their apprenticeship.

In order to solve the wage problem, a few foundries make a practice of studying the cost of living in their town and granting apprentices' cost of living plus a percentage, ranging from 10 to 70 per cent. The highest percentage is paid to apprentices in their last year of apprenticeship.

A handicap, which many foundries have applied to their apprenticeship systems, is "inertia of habit." Systems with the indentured agreements and rates of pay instituted 15 years ago, are still in use, although perhaps not operating.

Working toward the elimination of the effect of low wages, the four-year apprenticeship clause, the institution of proper incentives, etc., a plan is being developed whereby an apprentice's work, length of indentured period and compensation is dependent upon merit and accomplishment rather than time. This involves placing all apprentices on a two months' trial, and those accepted at the end of every six-month period are graded into classes as follows:

Class A, apprentices serving 825 hours per period.
Class B, apprentices serving 962 hours per period.
Class C, apprentices serving 1100 hours per period.

The compensation is as follows:

Periods of entire course	1	2	3	4	5	6	7	8
Per cent of journeyman's pay ..	33	36	39	43	47	52	58	66

To overcome the laborious and unsanitary conditions existing in many foundries, the adoption of sanitary, safety and labor-saving regulations, as recommended by the American Foundrymen's association and others is recommended. The following quotation from a letter received is indicative of what is being accomplished in this direction:

"* * * We are trying to gradually induce men to become foundry employes and to place the entire foundry on a higher plane, as we find that the average workman seems to feel that the foundry is hard work indeed and disagreeable place to work. To offset this, we have built what we believe to be the lightest, cleanest and best ventilated foundry in the United States; have installed lockers for the men's clothes, shower baths, drinking fountains, ample ventilation for summer and ample heating in the winter; which makes the foundry a comfortable and desirable place in which to work."

To eliminate the condition of monotony, and to work toward a sound, practical and definite training program, the committee recommends a more general routing of apprentices into the different branches of foundry work and co-ordinating this practical experience with definite, practical technical instruction.

The machine and tool industry in a few cities has sought to acquaint the public school authorities with the

From a paper presented at the Philadelphia convention of the American Foundrymen's association. The author, C. C. Schoen, was with the United States department of labor, training service, Stamford, Conn.

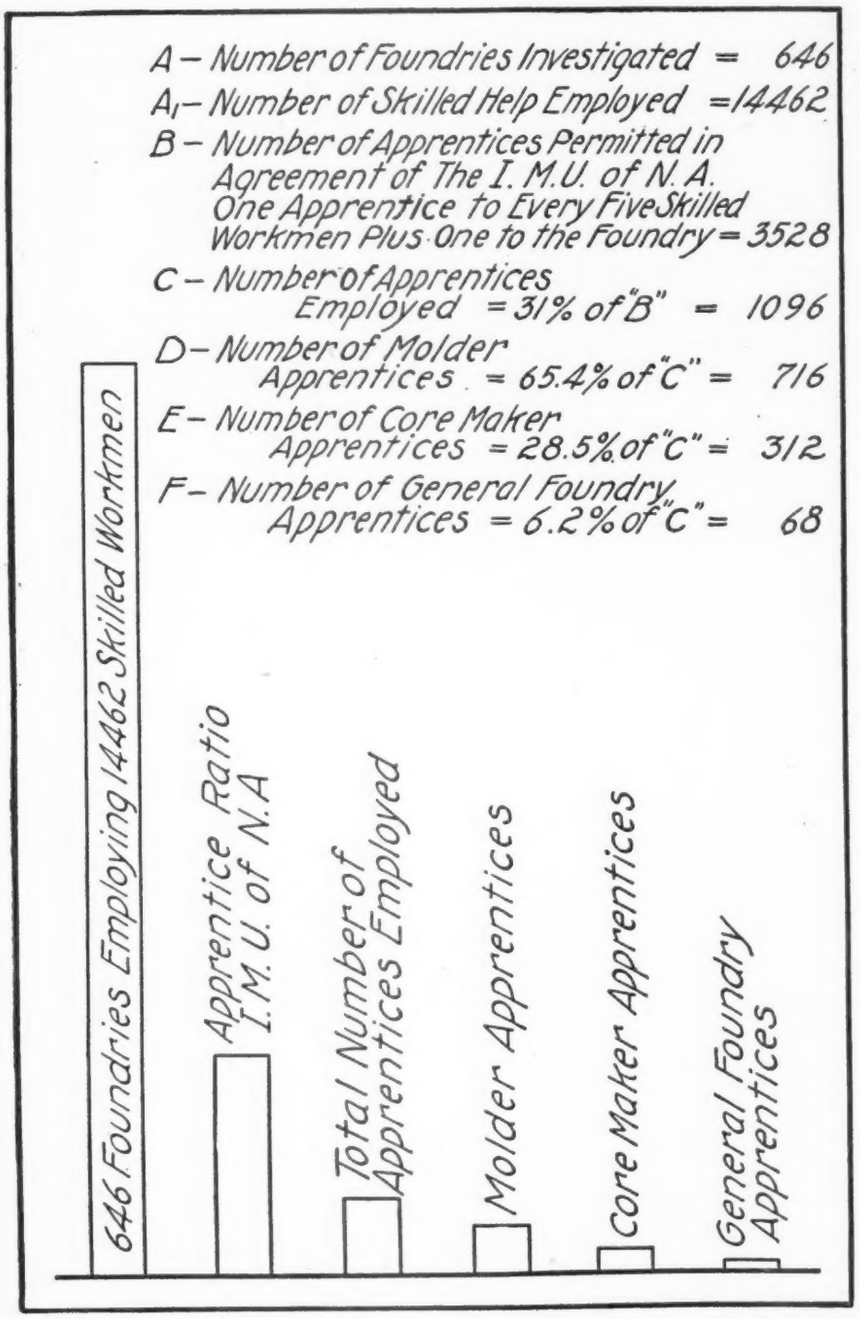

A – Number of Foundries Investigated = 646
A1 – Number of Skilled Help Employed = 14462
B – Number of Apprentices Permitted in Agreement of The I. M. U. of N. A. One Apprentice to Every Five Skilled Workmen Plus One to the Foundry = 3528
C – Number of Apprentices Employed = 31% of "B" = 1096
D – Number of Molder Apprentices = 65.4% of "C" = 716
E – Number of Core Maker Apprentices = 28.5% of "C" = 312
F – Number of General Foundry Apprentices = 6.2% of "C" = 68
646 Foundries Employing 14462 Skilled Workmen
Apprentice Ratio I. M. U. of N. A
Total Number of Apprentices Employed
Molder Apprentices
Core Maker Apprentices
General Foundry Apprentices

FIG. 1—CHART SHOWING RELATION OF NUMBER OF APPRENTICES TO TOTAL EMPLOYED AND TO TOTAL NUMBER POSSIBLE

importance of its trade by delegating a competent mechanic or engineer to lecture before the teachers' association on the character and importance of its work, and the opportunities existing for development. I am quite certain that a half-hour talk by a competent foundryman to a group of public school representatives would arouse in them a deep interest and respect for the foundrymen's trade.

The ease with which many young men, with limited knowledge and experience, can secure employment as journeymen is a direct result of lack of training. We have established a low standard in the foundry and apprentices apparently find a short term sufficient to measure up to the standard set.

The tendency of foundry employes to discourage apprentices must be overcome through education. Many employes sincerely and honestly discourage apprentices because they labor under unsanitary and unsafe conditions. There are other employes, however, who discourage apprentices because of selfish motives. Cases have been brought to light where journeymen and foremen advised apprentices that a study of technical subjects was nonessential and at the same time they secured for their private study copies of lessons given apprentices.

The inability of foundry owners to master their training problems is chiefly due to lack of knowledge of the subject and the fact that they too often delegate this work to an overburdened foreman or a person incompetent to effectively operate the plan.

A clear conception of the purpose in view, an understanding of the methods and kind of authority necessary to achieve this purpose, ability to secure co-operation, centralization of training responsibility, a definite training program, practical instruction, workable standards, accurate records, and a square deal, are essential to success.

Existing conditions in the foundry industry necessitate a more general use of the upgrading system, which involves an intensive short-time training of the present labor and semi-skilled help.

In order to meet this condition and at the same time pave the way for a broad training, the branches of training have been divided into units as

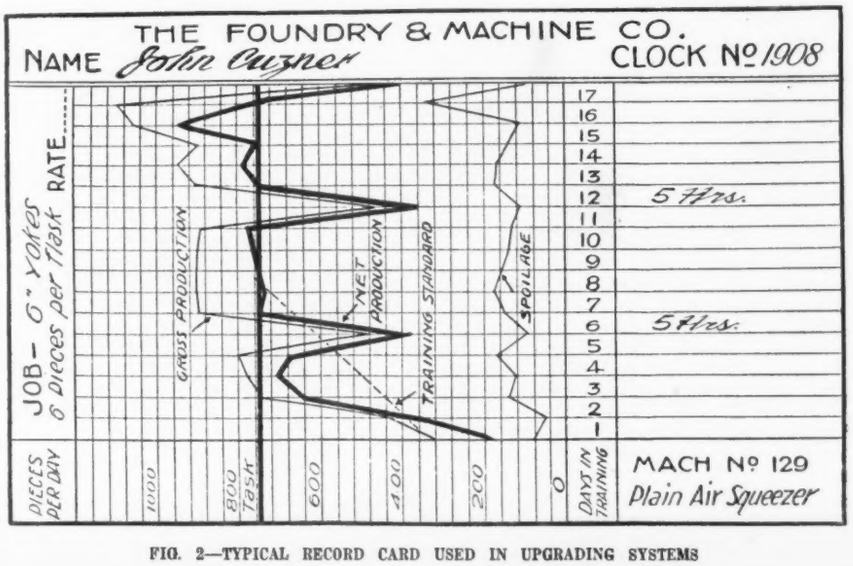


FIG. 2—TYPICAL RECORD CARD USED IN UPGRADING SYSTEMS

Branches of Training For Upgrading Foundry Students

WORKER IN CLEANING DEPARTMENT

Materials—Sand, abrasives, gases, acids, misc.
Equipment—Scratch brushes, chisels, hammers, files, etc.
Operations—Cleaning, finishing, assorting, repairing, mixing, applying.

ASSISTANT TO MELTER

Materials—Pig, scrap, flux, fuels, refractories.
Equipment—Shop and its construction.
Operations—Charging, firing, drawing, repairing.

POURING

Materials—Sands, clays, blackenings, misc.
Equipment—Shop and its construction.
Operations—Lining, baking, pouring, care of ladles.

COREMAKING

Materials—Sands, binders re-enforcements, fuels.
Equipment—Shop and its construction, coremakers'.
Operations—Mixing sands, ramming, venting, re-enforcing, baking.

MACHINE MOLDING

Materials—Sands, facings, partings, patterns, misc.
Equipment—Machines and their construction.
Operations—Tempering sands, ramming, re-enforcing, venting, finishing, setting cores, securing, pouring.

BENCH MOLDING

Materials—Sands, facings, partings, patterns, misc.
Equipment—Shop and its construction, molders'.
Operations—Tempering sands, ramming, re-enforcing, venting, finishing, setting cores, securing, pouring.

SIDE FLOOR MOLDING

Materials—Sands, facings, partings, patterns, misc.
Equipment—Shop and its construction, molders'.
Operations—Tempering sands, ramming, re-enforcing, venting, finishing, setting cores, securing, pouring.

CRANE FLOOR MOLDING

Materials—Sands, facings, partings, patterns, misc.
Equipment—Shop and its construction, molders'.
Operations—Tempering sands, ramming, re-enforcing, venting, finishing, setting cores, securing, pouring.

LOAM MOLDING

Materials—Sands, facings, partings, patterns, bricks, misc.
Equipment—Shop and its construction, rigging, molders'.
Operations—Laying bricks, sweeping, finishing, baking, assembling, securing, pouring basins.

ASSEMBLING

Materials—Sands, facings, chaplets, misc.
Equipment—Shop, assemblers'.
Operations—Lifting, setting cores, securing, pouring basins.

HEAT TREATING AND ANNEALING

Materials—Refractories, fuels, misc.
Equipment—Location, construction.
Operations—Charging, heating, drawing, repairing.

shown in the accompanying table to permit those desiring a broad training to gain experience and knowledge.

In instituting an upgrading system, consideration should be given to—

Centralization of training responsibility.
Definite training policy.
Location of training activities.
Competent instructor.
A detail study and analysis of each job in order to establish a standard time and a best method.
Issuance of standard practice instruction.
Record form, including standards of quality and quantity.
Follow-up system.

The record card, shown in Fig. 2, is representative of a type being developed at present.

In conclusion, the writer suggests that a definite stand be taken in regard to the following:

Extent to which apprenticeship training is essential.
A standard of merit and accomplishment toward which training should be directed.
A standard form of indentured period.
Branches of training.
Length of indentured period.
Character of instruction.
Securing co-operation of public schools and assistance through the Smith-Hughes act.
Hours and time of instruction.
A standard record form.
Compensation.
Incentive.
Reward to graduates.
The establishment of a central clearing house to gather, develop and distribute literature and information tending to develop knowledge and higher intelligence in foundry work.

The last suggestion has been submitted by Dr. Richard Moldenke, Pat Dwyer, and others. Mr. Dwyer has submitted a suggestion in writing as follows:

"Instead of trying to get a competent local instructor for each plant, a feat which is neither practicable or possible, a central bureau should be established. A series of condensed papers could be prepared on every phase of standard foundry practice, each one by an acknowledged practical expert in his line. Copies of these papers would then be available for any man anywhere who wished to take advantage of them. The merits of this plan are that only the best methods would be in circulation; only those who are really in earnest would take advantage of them; and by having a competent representative body to sponsor and finance the scheme, the cost would not be excessive in any particular case."

In the final analysis, the success or failure of this work will depend upon the extent to which foundries will institute and promote training in in their own shops. The problem should be handled in each locality, individually.

There is a strong tendency among foundrymen to let the other fellow do the training and a few foundries have stated that they are not bothering with apprentices because they employ only first-class molders and prefer to hire these finished mechanics as best they can.

If every foundryman will appreciate the fact that his experience and trained men will do most toward the progress of the foundry and then honestly and wisely endeavor to promote such training as is best applicable to his particular foundry, a start will be made, the results of which may far surpass expectations.

Organizes New Foundry

The Vassar Foundry Co. has been organized by J. C. Green and M. B. Giterson for the manufacture of light gray iron castings in Vassar, Mich. The company is capitalized at $40,000. Ground has been broken for the first of four units, each one of which will be 60 x 160 feet. It is expected that the first unit, employing 50 men will be in operation by Feb. 1 and the others will be finished and placed in operation during the year. J. C. Green, the president of the new company, also is president of the Modern Pattern & Machine Co., Central Pattern Works, Newlin Coreoil Co., and the Gratiot Welding Co., all of Detroit; and the Pattern & Castings Co., Saginaw, Mich. M. B. Giterson is manager of the new company.

Completes New Factory

The Lindsay Chaplet & Mfg. Co., Harrison building, Philadelphia, practically has completed a factory covering an area of approximately 19,000 feet at Marcus Hook, Pa., to be used exclusively in the manufacture of foundry chaplets and light metal specialties and employing about 50 workmen. The main building and extensions were constructed by W. W. Lindsay & Co., Inc., Philadelphia.

A core mixture recently patented by J. P. Elliott is formed by mixing pulverized asphalt with the core sand. As the asphalt lacks binding properties before it is melted, the inventor also adds flour to the sand to give it plasticity. The cores are baked until the asphalt melts.

FIGS. 1-4—VIEWS OF THE LABORATORY OF MARION STEAM SHOVEL CO., WHERE STEEL IS ANALYZED AND TEST BARS TESTED FOR PHYSICAL PROPERTIES

Making Manganese Steel by the Open-Hearth Process

Steel Containing 12 Per Cent Manganese is Made by Open Hearth Instead of Bessemer Process Usually Employed—Method of Adding Alloy and Quenching Heat Treated Castings Unique

BY E. L. SHANER

Fig. 5—Modern steam shovel dipper—The dipper front and teeth are of manganese steel

STEEL always has been an important factor in the development of equipment employed to perform the arduous tasks formerly accomplished by manual labor. This is especially true of steam shovels and dredging machinery, which have undergone a steady and rapid development since 1834 when the first power shovel was built at Springfield, Mass. The most notable improvements have taken place during the past decade when the demand for machines of large capacity and great power caused designing engineers to seek material especially adapted to the great variety of requirements imposed on the different parts of the machines. For instance, in certain castings used in the construction of power shovels, ability to withstand the abrasive action caused by contact with stone, sand, slag and similar substances is essential. It is particularly important that dipper fronts and teeth possess this property. By constant study of the requirements for steel working in contact with steel, engineers have taken cognizance of the fact that pinions are subjected to far greater wear than the gears with which they mesh. To equalize this difference, the pinions have been made of steel having greater resistance to wear than the steel of the gears. This is only one instance of many in which special specific demands have been made of the materials entering into the construction of excavation machinery.

Manganese is known to impart unusual toughness to steel and for this reason manganese steel is generally employed in parts subjected to excessive wear. The common practice at present followed by manufacturers of manganese steel for this purpose calls for a manganese content of from 11 to 14 per cent.

When manganese steel was first made in the United States, steelmakers employed the acid bessemer process for melting the steel and added the required amount of manganese as the metal was being tapped. Either this practice with slight modifications, or the electric furnace process now is followed in practically all manganese steel works in this coun- with but few exceptions. One of the makers of manganese steel employing the open-hearth furnace is the Marion Steam Shovel Co., Marion, O. In common with other firms, the Marion company first employed converter steel as the basis of its manganese product, but several years ago open-hearth metal was adopted for this purpose and has been used with unusual success.

The company's preference for open-hearth metal is based upon the belief that with this process it is easier to maintain the phosphorus content at the low percentage desired. Moreover, the authorities at this plant are convinced that not nearly as many impurities are carried into the metal poured from open-hearth steel as in that in which converter steel is the base. As is well known, bessemer steel requires more deoxidation than open-hearth steel, and it is pointed out, therefore, that the addition of manganese to open-hearth metal, in which the real need of a deoxidizing agent is less than in the case of converter steel, leaves the resulting product unusually free from impurities.

At Marion the making of manganese steel is carried on in the steel foundry where castings ranging in weight from one pound to 16 tons

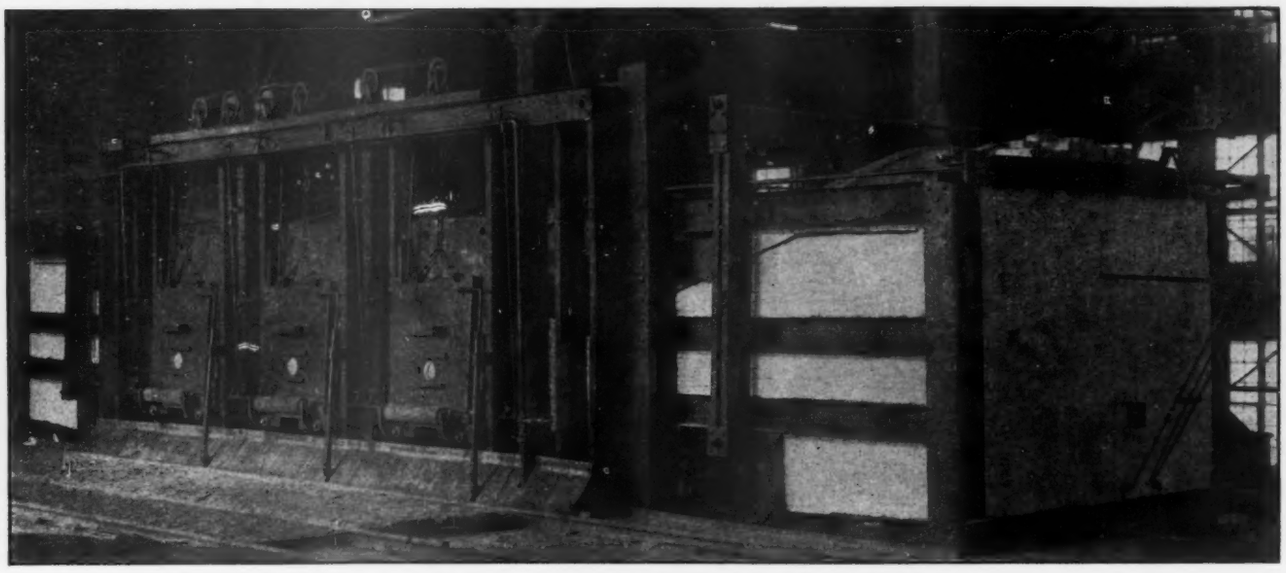


FIG. 6—VIEW OF A 20-TON OPEN-HEARTH FURNACE FROM CHARGING SIDE

are made. The tonnage of manganese steel averages approximately 5 per cent of the total output of the foundry. In October, a month somewhat below the average in production, 63,636 pounds of manganese metal was poured.

Description of Foundry

The melting equipment consists of a 20-ton, nontilting, basic open-hearth furnace and a small oil furnace for ferromanganese. The open hearth is at the south end of the east bay of the steel foundry and is served by a floor-type charging machine made by the Wellman-Seaver-Morgan Co., Cleveland. The molding floors extend the entire length of the main bay and northward from the charging platform in the east bay. The main bay is commanded by one 30-ton and two 10-ton electric traveling cranes and the side bay by two 10-ton cranes. The cores, which are made in a core shop situated in the east bay, are baked in a coke-fired oven adjoining the east wall of the building. Molds are dried in a car-type, oil-fired oven outside of the foundry building. Provision has been made for moving oven cars by means of steel cables operated by power-driven drums.

A novel arrangement has been adopted for handling the molten metal preparatory to pouring. When it is desired to make a heat of manganese steel, the furnace operator is given instructions to make steel of the required analysis. In the meantime, the necessary amount of 80 per cent ferromanganese is charged into the small furnace.

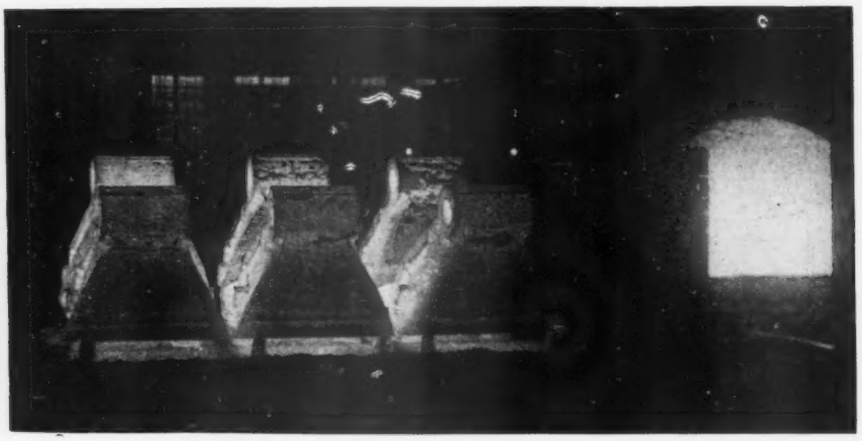


FIG. 7—REPRODUCTION OF PHOTOGRAPH TAKEN AT NIGHT OF CASTINGS ON CAR JUST REMOVED FROM HEAT TREATING OVEN AND ABOUT TO BE THROWN INTO QUENCHING TANK

A large ladle is placed on the platform of floor scales directly under the spout of the small furnace, and the balance weights are set for the amount of manganese required, proper allowance being made for the weight of the ladle. In predetermining the exact amount of metal to be tapped, the condition and quantity of slag is taken into consideration. After the manganese has been tapped into the ladle, the balance weights are adjusted for the addition of open-hearth metal, which is bottom-poured from a large crane ladle. The rush of molten steel into the bottom of the mixing ladle has a stirring effect upon the contents and thoroughly distributes the manganese.

Process Modified if Desired

Another method of mixing which has been used successfully consists of pouring a quantity of open-hearth steel into the mixing ladle, adding the manganese, and then the remainder of the open-hearth metal. With either of the methods described it is possible to produce metal conforming to the following specifications: Carbon, 1.10 to 1.30 per cent; phosphorus, 0.055 per cent (maximum); sulphur, 0.04 per cent (maximum); and manganese 11 to 14 per cent. Steel of this analysis is used for dipper fronts, teeth, rack and pinion castings, elevator dredge buckets, latch plates, wearing plates, propelling gears, pinions, etc.

Just prior to pouring, the metal is thoroughly teemed to insure soundness. In distributing the molten steel to the molds, it is bottom poured from the ladle in which the open-hearth steel and manganese were tapped at the furnaces. As a rule the metal is handled in 6-ton ladles, it being possible to fill two ladles of this size from each heat of the open hearth. The capacity of the furnace is three heats per day.

After the molds are shaken out the castings are ready to be cleaned in a building south of the steel foundry which is entirely devoted to this work, after which they are subjected to the usual heat treatment for manganese steel. This consists of heating the castings to a temperature of about

1800 degrees for approximately 8 to 20 hours depending on the size and shape of castings, followed by quenching in water. The equipment for heating and quenching is decidedly novel.

The cleaned castings are placed on oven cars, the front doors of the ovens resting on one end of the cars. Each of the two ovens is about 6 feet wide by 14 feet long and is hand fired with coal. The temperature of each is registered by electric pyrometer recorders in the office of the company metallurgist. When the castings are ready to be taken from one of the ovens, a steel cable is hooked to the car and it is slowly drawn out by means of a power drum.

As the car is drawn from the furnace it runs on a track pivoted longitudinally over the quenching tank shown in Fig. 9. As the car nears its position on the tilting portion of the track a workman throws a lever which raises two hook-shaped castings to a vertical position, where they engage the axles of the car, which is held tight against the hooks by the tension of the cable. The car being securely clamped to the track, air is admitted to an air cylinder underneath, the rising piston of which tilts the track to an angle of about 45 degrees, where further tilting is prevented by wooden stops. The rapid tilting of track and car causes the castings to slide off into the quenching tank, which is filled with water. The castings are recovered by means of a traveling crane which spans the tank and is operated from a nearby control station.

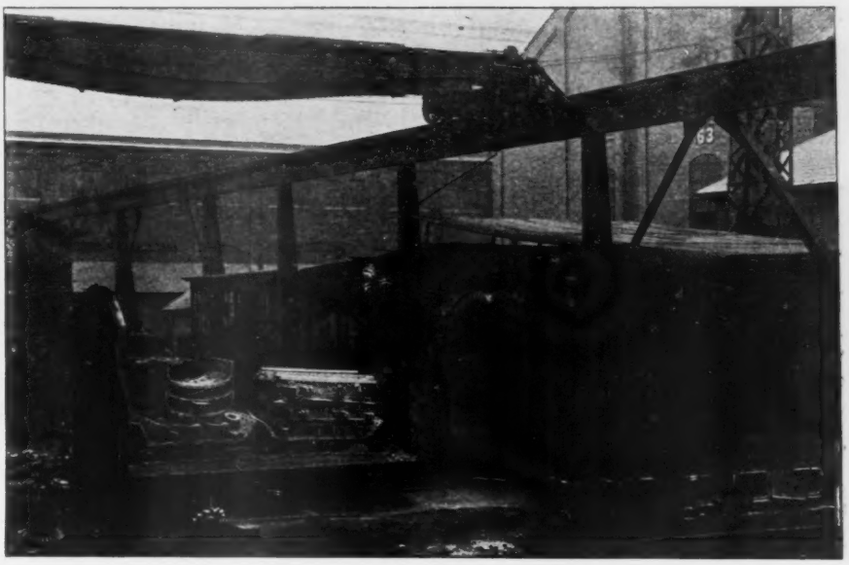


FIG. 9—OVEN CAR ON PIVOTED TRACK DIRECTLY OVER THE QUENCHING TANK—AFTER CAR IS ANCHORED TO TRACK BY HOOK OVER AXLES, TRACK AND CAR ARE TILTED TO ANGLE OF 45 DEGREES WHICH IS SUFFICIENT TO HURL ALL CASTINGS INTO BATH SIMULTANEOUSLY

In order to keep a close check on the chemical composition of the steel, the metal of each ladle is completely analyzed in the well-equipped laboratory maintained by the Marion company. Test bars are taken from each ladle tapped from each heat, and carry the date and heat number for identification. Each test bar remains with the castings throughout the heat treating process, after which it is tested for physical properties. In case a defect is revealed by the testing of a bar, all of the castings poured from the heat are again heat treated. Another test for physical properties is

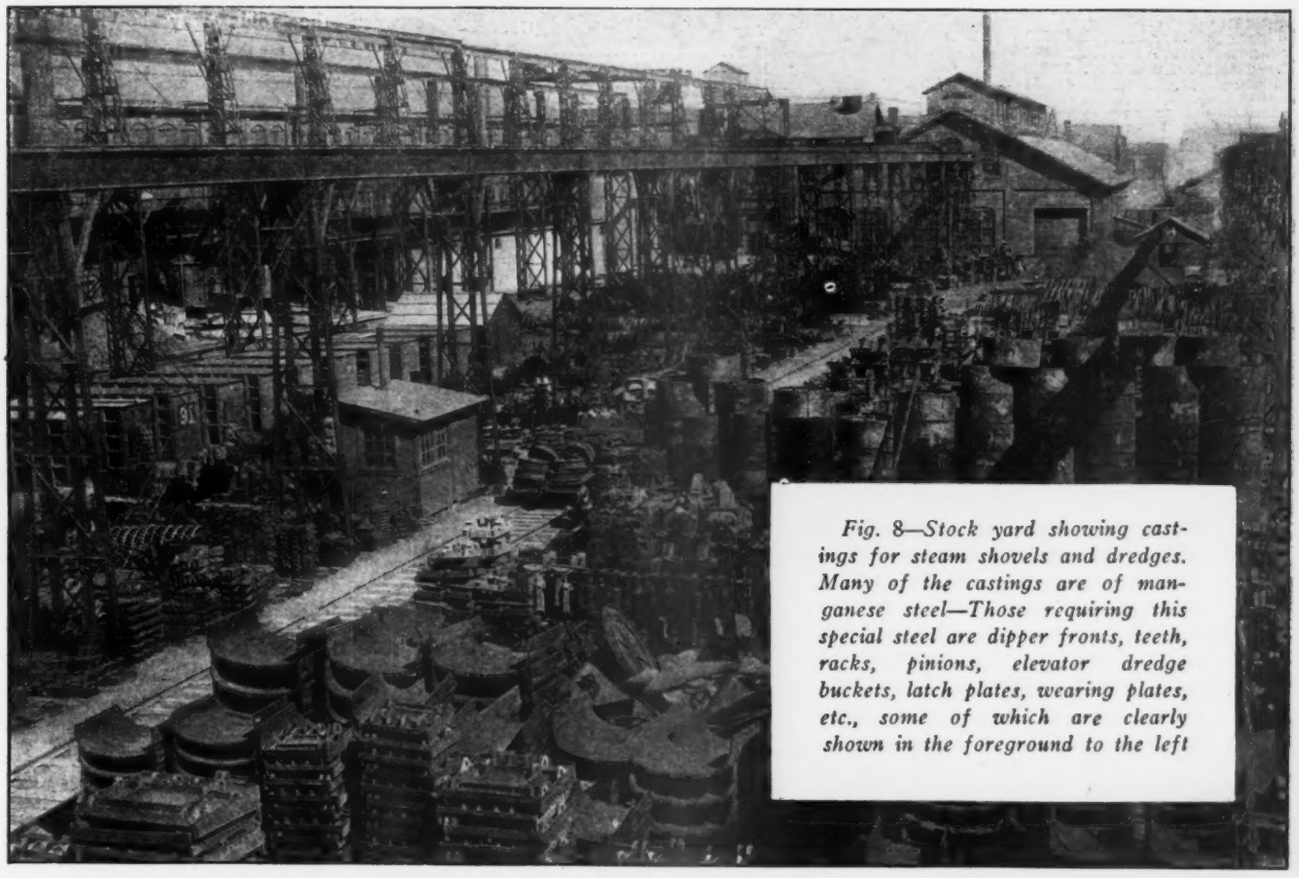


Fig. 8—Stock yard showing castings for steam shovels and dredges. Many of the castings are of manganese steel—Those requiring this special steel are dipper fronts, teeth, racks, pinions, elevator dredge buckets, latch plates, wearing plates, etc., some of which are clearly shown in the foreground to the left

made and if no defects are revealed the castings are considered satisfactory for use. In case the test indicates that undesirable qualities still are present, the entire heat is thrown out.

Although comparative costs of the bessemer and open-hearth processes for making manganese steel are not available, the estimates made by the company based upon melting losses indicate that the open-hearth process is as economical if not more so than the more generally used converter method for making the same castings.

The steel foundry of the Marion company is in charge of Marshall Post, and the laboratory work and all problems pertaining to the metallurgy of metals are under the direction of Ralph Young, metallurgist.

How Tie Rods for Ore Docks Were Welded

THERMIT welding was employed by the Algoma Steel Corp., Ltd., Sault Ste. Marie, Canada, in an emergency last July. It was necessary to make 13 pieces of 3¼-inch square rods by welding four pieces together in each case. This required three welds for every rod, making 39 welds in all. When finished they were to be used as tie rods from a concrete ore dock to an anchor wall. This required a length of 185 feet. The nature of the subsoil and the excessive loads of ore placed in storage back of the dock made it necessary to get a substantial tie-back to prevent any slip in the concrete wall. Therefore, any defect in the weld which would have caused weakness and allowed the bar to break would have been serious.

Tensile Tests Made

Three tensile tests were made of thermit welds with the following results:

	Tensile strength Lbs. per sq. in.	Elongation % in 2 in.
Original bar	48,560	52.5%
No. 1 weld	27,000	2.5%
No. 2 weld	52,200	6.0%
No. 3 weld	44,880	4.0%

The average tensile strength of these tests show the bar to be 85 per cent as strong in the welded sections as it was in its original form. Sample No. 1 had a slight pipe in it and the result of the test would indicate that this probably caused a considerable reduction in its strength. In preparing the sections for the tests of the newly welded portions, a short piece of the 3¼-inch square rod about seven inches long containing the weld was cut out. This was put in a crank shaper and machined to flat surfaces on three sides. It was then put under a power hack saw and quartered. Three of these quarters were then turned down to test pieces having cross sectional area of 0.7854 square inch, or about 7½ per cent of the cross area of the original bar.

The results of these tests decided the Algoma company to use the thermit process for welding the bars in spite of the difficulties to be encountered in the application of this method of welding. Boats were due at the dock within a week and the water was high, with not sufficient time to properly cofferdam each weld. However, by the use of a steam pump and constant bailing, the water was kept low enough to get at the welds and work started on July 9. It was completed on July 17, in the following order:

July	Welds
9th	3
10th	3
11th	5
12th	5
13th	5
14th	5
15th	5
16th	5
17th	3
Total	39

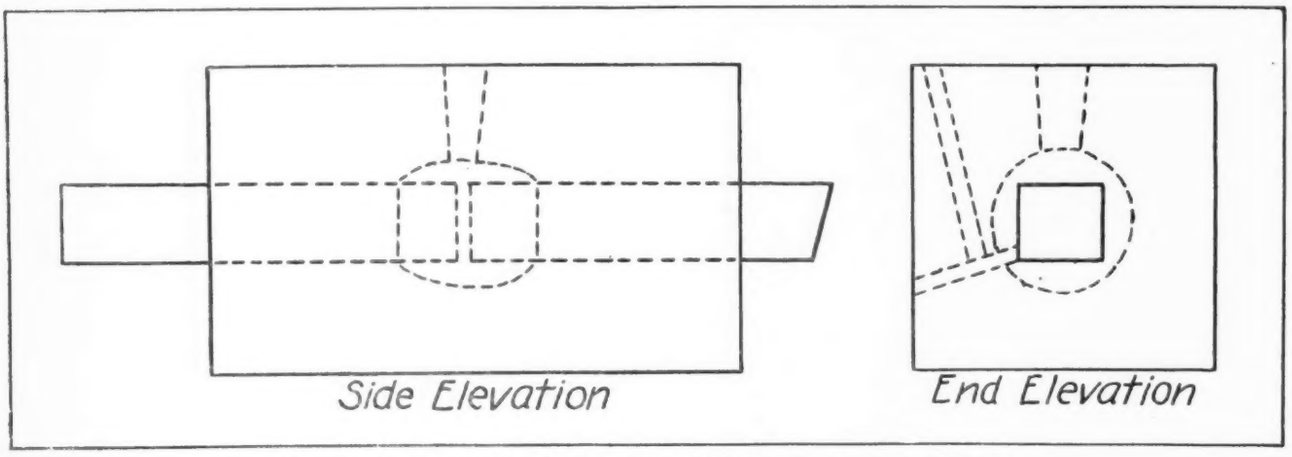
This work was done by Charles Fosberg with a force of six workmen. About 40 pounds of thermit was used for each weld and, on an average, two hours were required for heating a weld. The accompanying sketch shows roughly a mold on place on a bar with the method of gating.

Venting Method Provides Free Passage

By J. C. Klohn

A device which can be used to advantage in cores which are difficult to vent is made from fly screen and bees wax.. For example if a vent is needed 2 x ¼ x 24 inches, cut a strip of common fly screen 6 x 24 inches and run it through melted bees wax which will fill all the square mesh. When the wax has set, make three folds on the 6-inch width and the vent will be complete. This vent may be bent to any desired shape and rammed up with the core. The heat of the oven will melt the wax and leave a clear open vent through the core. The vent may be made any size or shape necessary. If a large vent is wanted the space between the folds may be filled with hay, straw, or burlap to provide greater strength when the mold is rammed.

The American Metallurgical Corp., Franklin Trust building, Philadelphia, has closed a contract with the York Hardware & Brass Works, Inc., York, Pa., for the installation of a 1000-pound revolving electric Weeks furnace for melting brass and copper alloys in its nonferrous casting plant.



CONSTRUCTION OF MOLD BOX FOR WELDING TIE RODS, SHOWING METHOD OF GATING

Melting Brass in a Gray Iron Shop

Considerations That Should Govern the Occasional Production of Nonferrous Castings and the Importance of Correct Melting are Emphasized —Types of Melting Mediums and Methods Described

BY R. R. CLARKE

PROPER melting stands pre-eminent among the factors entering into successful brass foundry practice. More defective castings result from poor melting methods than from all other causes combined. It is a foundry axiom that "some molders make their own scrap but furnaces can make scrap for everybody." The importance of providing proper equipment and of supervising the operation cannot be over estimated. It is not the purpose of this paper to discuss in intimate detail every phase of brass foundry practice. It simply covers in a general way the features confronting those who have, or who contemplate installing a brass melting unit in their iron foundry.

Every detail has its melting peculiarities both when in a single and combined state. These peculiarities must be kept constantly in mind for they have a direct bearing on the final results. It is a common, but not commendable practice among iron foundrymen to use loose brass scrap of unknown composition. A pile of miscellaneous scrap may contain samples of yellow brass, red brass, Tobin bronze, manganese bronze and several other varieties. A composition of this character when melted yields bad metal with physical characteristics which render it unfit for any definite use.

Judging Brass Scrap

Experienced brass men can judge brass scrap fairly well by the color, appearance and fracture. The best brass foundries do not depend upon the judgment of anyone. They either maintain laboratories of their own or they have samples of the metal analyzed by commercial chemists before using it. The safest course for the executive of an ordinary iron foundry which handles brass only as a side line is to purchase brass scrap metal ingots of known analysis. The price is but slightly higher than that of loose brass scrap.

Broadly speaking, scrap ingot may be divided into two classes, that containing an appreciable quantity of zinc and that containing little or none. Zinc is needed in the production of golden colored metal, in most castings subjected to pressure and in those where softness and toughness are desired. Tin is substituted for zinc in castings where hardness and bearing qualities are needed.

If the iron foundries doing occasional brass work would keep two kinds of ingots on hand, the one inclusive and the other exclusive of zinc, and at the same time carry a limited stock of virgin copper, tin, lead and zinc they could approximate at reasonable cost a high grade alloy of almost any desired constituency. They could do this by adding one or more new metals at the expense of others in the ingot as the case might require. Out of an ingot approximating copper 80 per cent, tin 10 per cent and lead 10 per cent, which is an excellent bearing metal, they could by adding 90 pounds of copper and 10 pounds of zinc to 100 pounds of the ingot realize a high grade red brass applicable to the average purpose. This metal would approximate very closely the formula copper 85 per cent, tin 5 per cent, lead 5 per cent, and zinc 5 per cent, which is quite common and reputable in brass foundry work.

When loose and indiscriminate scrap must be used some effort at least should be made to pick it over and secure the best for the more particular cases. The better grades of brass usually will be found in such castings as valve bodies, stems, disks, bonnets, glands, plugs or keys; and also in the better class of plumbing goods, in locomotive steam castings and in most cases where the casting is known to have rendered some particular red brass service.

In making up alloys altogether from new metals, the order of adding the metals is important. The general and safe rule is to melt the copper to a fair liquid state, add the tin and lead and finally the zinc, stirring the bath well during the entire process.

The eternal vigilance of the brass foundryman is required to prevent his alloys from being contaminated with iron. Its presence is detrimental to all nonferrous mixtures with the possible exception of Parson's manganese bronze which carries an average of 1 per cent iron.

Brass may be melted in a pit furnace with a crucible using either natural or forced draft. The air and oil furnace, the gas-fired furnace, the electric furnace and in some cases the cupola also are employed. Pit melting with proper equipment is efficient, but at the same time is expensive, owing to the high cost and comparatively short life of the crucibles. Certain relative dimensions must be observed in building a pit furnace and something more than a mere hole in the ground lined with fire brick and connected with a stack is required.

Melting Practice

Good practice in pit melting consists in maintaining a uniform and substantial coke bed under the bottom of the crucible; in keeping the crucible in an upright and central position; in using care to prevent coke from falling into the metal and in excluding the air from the surface of the molten metal. One of the most efficient and best known measures for accomplishing this purpose is to cover the exposed surface of the metal with powdered charcoal. Pulverized glass is sometimes used, as it melts and forms an ideal cover.

Pit melting expense can be greatly reduced by proper care of crucibles. In this connection the following hints are pertinent:

New crucibles and crucibles not in use should be kept in a warm, dry storage room. In an ordinary shop the core oven is the best place.

Crucibles should be properly annealed before using. Proper annealing consists in raising the temperature slowly to at least 150 degrees Cent. The surface also should be heated uniformly. Care should be observed to avoid striking them with the bar when poking the fire.

Pigs or chunks of solid metal never should be forced into a crucible in wedge formation.

Heels of metal never should be allowed to freeze in the crucible.

Tongs should be made to fit the crucible snugly and kept in proper condition.

Throwing heavy pieces of metal into the crucible carelessly is destructive practice.

When melting with gas or oil the crucible should not be left in the path of the flame jet.

Pit melting by gas instead of coke is quite practical, the only factor to be considered being the relative cost of fuel. Insofar as the quantity and

---

Abstract of paper presented at the Philadelphia convention of the American Foundrymen's association Sept. 29–Oct. 3, 1919. The author, R. R. Clarke, is with the Eagle Brass Foundry, Seattle, Wash.

quality of the resulting molten metal is concerned there seems to be little if any difference.

Melting with oil, when properly handled, is an efficient and convenient method. Dependable auxiliary equipment is essential to its success. A satisfactory air supply is indicated by ample volume rather than by great pressure.

The proper flame, which means the correct proportion of air to oil, is judged best by the color. A flame which is too white and clear or one tinged with green is oxidizing and decidedly detrimental. A soft flame, clear and almost smokeless, faintly tinged with yellow is to be preferred. The temptation to conserve oil is always strong but it is well to remember that oil is cheaper than metal.

Operating the Furnace

The following points should be given careful attention in operating any type of oil furnace:

Keep the furnace clean. Slag out and clean it after every heat.

See that there are no defective or bare spots in the lining.

Do not permit too much slag to accumulate on the molten metal.

Watch the flame closely and maintain a moderate reducing flame.

Use a good grade of oil.

Do not allow the air to be turned on while the oil is not being supplied.

In melting large heats change the position of the furnace frequently by rocking it.

Never expose the metal to the flame after the pouring temperature has been reached. Soaking metal is one of the primary evils of melting and a prolific cause of defective castings.

Melt and dispose of the metal as quickly as possible.

Keep the surface of the metal covered with charcoal.

After the bath has been reduced to a fairly liquid state open the furnace, skim off the accumulated slag and dross, throw on a good sized shovelful of coarse charcoal. This is the only interruption that should occur during the melting process.

When transferring metal from the furnace to the mold, the ladles should be clean and well preheated. The surface of the metal should be kept covered with fine charcoal.

Cupola melting has never been favorably considered by brass men. It is feasible and where a large quantity of metal is needed at one time quite practicable. We have found it so in melting foundry sweepings, screenings, etc., and we know of high grade manganese bronze having been made in the cupola. In making this latter metal the copper was melted in the cupola and the zinc stirred into the hot copper bath after it was in the ladle.

The two principal evils attending brass melting are oxidation and gas absorption. Practically all known metals at certain temperatures combine readily with oxygen, producing either an oxidized metal or a complete metal oxide. The difference between "oxidized metal" and metal oxide is that between a metal only partially oxidized and one completely oxidized. In the one case the metal is scorched and in the other it is completely burned to dross or ashes. Oxidation increases with temperature, with exposure and with time. To minimize oxidation in melting then means to get the metal no hotter than necessary, keep its surface well protected from the atmosphere and get it out of the furnace and poured as soon as it is ready. Oxidation causes weak, drossy and spongy metal, wholly unfit for any general purpose.

Gas absorption consists in the taking up of gases by molten metal at high temperatures and releasing them in the process of solidification. The active and expelling stage of these gases is strong in the plastic state of the metal and results in a most distressing honeycombed and porous effect in the casting. Though given considerable study by both practical and technical men, the nature and origin of these gases have not been definitely determined or at least agreed upon. That they are allied more or less intimately with oxides and oxidation seems fairly certain since they arise from similar conditions and respond in part at least to like cures. A fairly complete discussion of their nature, cause, prevention and remedy will be found on page 121 of the March, 1919, issue of THE FOUNDRY, and those interested may find this discussion of value. It is only necessary here to remark that this condition is usually characterized by a swelling up of the gate head in cooling and follows such evils as poor grades and bad combinations of metals, dirty and slag-polluted furnaces, damp furnaces and ladle linings, poor grades of fuel, soaking the metal, and extremely high pouring temperatures.

The rule is fairly general, though not infallible, that a correct pouring temperature will offset the evil even though the metal at that temperature represents reduction from a higher one.

The cure lies in the fluxes, which are of two kinds, neutral and active, representing respectively those that do not become a corporate part of the metal nor alter its inherent properties and those that do. Of the neutrals, the most common are charcoal, plaster of paris, and common salt used principally as surface coverings.

Charcoal is carbon and at its kindling temperature has a great affinity for oxygen. Oxides floating on the surface of the metal are combinations of oxygen and metal. The function and power of charcoal is to take up the oxygen of the oxide and leave the metal clean and clear. This it does admirably, besides forming a protective covering to exclude the atmosphere. Charcoal's greatest value is in the burning which represents the chemical reaction or oxidizing process. Obviously then the top of the metal in the ladle should be well covered during pouring, with charcoal in a burning state. Once burned to ashes its function practically ceases.

Active fluxes are sometimes referred to as reagents and deoxidizers. Always they are highly oxygenating substances. Most common among them are zinc, phosphorus, silicon, magnesium and manganese. But three of these will require comment here, they being the most widely used and covering general requirements. If pure copper is melted and poured into molds, the chances are greatly in favor of its rising and flowing back through the pouring gate, resulting in a porous and oxidized casting. If to this pure copper, 3 per cent of zinc, or ½ of 1 per cent of phosphorus, or a small amount of silicon are added, the evils will at once be corrected. In the copper tin-lead alloys, zinc or phosphorus only are used.

Zinc seldom is used for deoxidizing purposes exclusively while phosphorus exclusively is commonly employed. The reason is that in a great many alloys zinc is used for the quality it supplies and because its presence obviates the need of any further reagent. With phosphorus, this is not the case. It is used purely as a deoxidizer in those alloys from which zinc and its qualities are barred. Zinc quality is wanted in pressure-resisting metals, so it forms an equal part with tin and lead in the 85 copper alloy. It is not wanted in a bearing metal, so the 80-10-10 copper, tin, lead alloy is fixed up with from 0.5 to 1 per cent of phosphorus. The use of both zinc and phosphorus in the same alloy is considered bad practice, especially high percentages of either. Used purely as a deoxidizer from 2 to 5 per cent of zinc and from 0.25 to 1 per cent of phosphorus will suffice.

Zinc and Phosphorus Burn

With high temperatures and repeated remelting, both zinc and phosphorus burn out of the alloy. In melting all scrap it is therefore good practice to add small quantities, from 1 to 2 per cent of zinc and 0.1 to 0.25 per cent phosphorus.

Phosphorus is added to the alloy in the form of a concentrate which itself is an alloy of either phosphorus and copper or phosphorus and tin and known respectively as phosphor-copper and

phosphor-tin depending on the base.

Relying on phosphorus as a cure-all for loose melting practice is bad policy and it should be resorted to at times and in quantity only as unavoidable conditions require. Silicon is used almost exclusively with pure copper to reduce its gases and oxides. The use of manganese and magnesium is not widespread. Chloride of zinc is generally used as a covering and flux for aluminum.

Cleanliness and solidity of brass castings depend largely on the casting temperature. Cold metal causes shrinking, drawing, drossy and spongy metal and improper union between different metal sections of the same casting. A porous and honeycombed structure is often the result of pouring the metal at too high a temperature. There is a considerable loss of heat in carrying the metal from the furnace to the mold. It cannot be checked, but it may be retarded to a certain extent by furnishing clean, preheated ladles and by handling the metal as rapidly as possible. It may be regarded as a fundamental principle of good brass melting practice to get the metal no hotter than absolutely necessary and then pour it immediately.

Checking Mistakes in Stock Records

(Concluded from page 50)

should be 385 pounds on hand. To balance this discrepancy 385 pounds of iron were added to the report of iron used, Fig. 2, for the week ending Aug. 30. By this method the amount of pig iron is always accurately known and errors in weight are corrected. Stocks of coke, steel scrap and gray-iron scrap purchased, are recorded in a similar manner. But the scrap and sprues from the home foundry are handled somewhat differently. The amounts used and received are entered on a card each day and occasionally adjustments are made on the card based on estimates of the amount of hand. These estimates can be closely made at times when the stock is low.

Form Sales Corporation

The Shawinigan Products Corp. has been organized to handle ferroalloys and Canadian carbide in the United States. The new company will be controlled by the Canada Carbide Co. interests. Julian C. Smith will be president and L. F. Loutrel, formerly manager of the ferroalloys department of Fairbanks, Morse & Co., and vice president of the Canada Carbide Sales Co., will be vice president and general manager of the new company. The remainder of the personnel will be largely the same as that of the old Canada Carbide Sales Co. Temporarily the new company will be located at 30 Church street, New York.

The carbide plants whose product will be sold in this country by the Shawinigan Products Co. are those of the Canada Carbide Co. at Shawinigan Falls, Canada, and at Meritton, Can. The company also will sell the products of the Shawinigan Electro Products Co., Baltimore, and the Southern Ferro Alloys Co., Chattanooga, Tenn.

Bureau of Standards Will Promote Safety

As a result of the conference called by the bureau of standards at Washington, D. C., in December, it is probable that within a short time a definite start will be made in the formulation of uniform safety standards, beginning with those subjects on which rules are now being formulated or revised by state or other authorities.

The Washington meeting was attended by about a hundred representatives of trade associations, engineering societies, state industrial commissions and labor departments, government officials, large employers of labor, and insurance committees and bureaus. The program included a presentation of a large number and variety of conflicting safety codes in existence and an outline of the efforts which have been made thus far to secure uniformity. The conference voted unanimously to approve the plan of formulating safety standards under the general auspices of the American engineering standards committee.

To expedite matters the conference session voted that a general advisory committee should be formed to include representatives of all national associations, state commissions, and others legitimately interested, to survey the whole field of safety standards and recommend which standards should be undertaken first and what organizations should sponsor them. The conference further recommended that such representative committee be organized by the national safety council, the bureau of standards, and the International Association of Industrial Accident Boards and Commissions.

At an informal meeting of representatives of these three organizations, plans were made for organizing the general advisory committee at once. Information will be gathered as to what rules are now in existence in the various states and the general advisory committee will recommend that these subjects be given first attention. This committee will report to the American standards committee not later than Feb. 1, and the definite assignment of sponsorship to the national safety council, the bureau of standards and others will follow.

Building Large Foundry

The new additions now being constructed at the gray iron foundry of the Universal Winding Co., Auburn, R. I., will make it one of the largest in that state. The complete foundry will be 470 feet long and 159 feet wide. Additions now under way will provide facilities for melting 50 tons of metal per day and the equipment for all foundry purposes will be the most modern obtainable. Two additions comprise the extension to the present building and these will practically double its capacity both in space occupied and in general equipment.. E. F. Parks is general superintendent.

Mines Domestic Graphite

A company with a capital of $250,000 has been formed to purchase and operate the graphite mine and mills owned by Hooper Bros., Whitehall, N. Y. The company will continue the manufacture of flake graphite and has already in operation a large concentrating plant built in 1916. The mine according to the report of the New York state geologist contains 1,500,000 tons of available ore. The refining plant is situated on the main line of the Delaware & Hudson railway and it is expected that this plant will be enlarged in the near future to care for the manufacture of paints, greases and other associated lines. The officers of the company follow: President, Frank C. Hooper; vice president, Roscoe B. Hayes; secretary, Frederick B. Richards; treasurer, Geo. Hooper.

A Correction

The furnaces and lifting lever at the foundry of the John Harsch Bronze & Foundry Co., shown in Fig. 8 on page 917 Dec. 15 issue of THE FOUNDRY were installed by the Foundry Equipment Co. of Cleveland and instead of the American Foundry Equipment Co., New York, as was stated.

The Vancouver Pipe & Foundry Co., Ltd., Vancouver, Canada, has been purchased by J. S. Tail of J. S. Tail & Co., Ltd., that city.

How and Why in Brass Founding

By Charles Vickers

Shrinkage Cracks in Chill-cast Aluminum

We have been trying to cast aluminum around a steel core, but find that as the metal cools it will crack, owing to the great contraction. We melt scrap aluminum from crank cases. We would like to learn if this difficulty can be overcome by the use of a different mixture of aluminum, and if not whether there is any other manner in which it can be avoided.

There is no way of overcoming the cracking of aluminum cast around a steel or other rigid core, provided the metal is allowed to cool on the chill. The practice in casting nonferrous metals is to pour the metal into a mold, let it cool until cold, or partially cold, then stripping the casting and cleaning out the cores. This practice will not bring good results when non-collapsible cores are used. In this case, it is necessary to have the mold mounted on a machine that will enable the cores to be positively and quickly withdrawn when the metal has reached a certain stage of solidification, and before the contraction that causes cracking begins. It is obvious the cores cannot be withdrawn by hand after shaking out the casting; they must be withdrawn by mechanical means, and this requires a "die-casting" machine. The only alternative is to devise collapsible steel cores made with a key piece in the center which is withdrawn after the core is set in the mold, and when this center is withdrawn the circumference of the core must be so designed that it will contract when squeezed. Made in this manner the core will not resist the contraction of the metal, and the casting will not be broken.

Nonshrinking Alloys

We would like to obtain the formula for a non-shrinking white metal suitable for match plates with the pattern cast on; also a good alloy of white metal for separately cast patterns.

There is no nonshrinking alloy. All metals and alloys shrink to some extent; some, however, less than others. An alloy of 50 per cent zinc and 50 per cent tin, has little shrinkage and is the alloy usually employed for patterns. If 3 per cent bismuth is substituted for 3 per cent of the zinc in the mixture, the shrinkage of the alloy is further reduced. The shrinkage is perceptible in the case of long patterns, but for the ordinary run of castings made from patterns in white metal, the shrinkage is too small to notice.

Another so-called nonshrinking white metal of a different character consists of tin, 45 per cent; lead, 45 per cent; antimony, 5 per cent; bismuth, 5 per cent. In running the zinc-tin alloy, if a small piece of sheet aluminum about one inch square is dissolved in the bath the alloy will produce cleaner castings.

What is Aterite?

We have received an inquiry for castings of a special metal known as "aterite," which is claimed to be non-corrosive and is used principally for couplings, valve fittings and the like. The alloy has a black appearance which makes it unattractive to thieves, but internally it looks like brass. It is claimed that this metal as scrap is objectionable should it be mixed in a pot of regular red brass. We would appreciate any information you can give us.

Aterite is a nickel silver low in nickel and containing both iron and lead. It contains 4 per cent of iron and it is this metal which makes its use objectionable in brass or bronze because this amount of iron will blacken the castings, even if only a small addition of the aterite is made. The iron also probably would segregate in nodules of extreme hardness which would make machine work difficult.

It would be advisable to purchase the metal in ingot form from the manufacturers and then to recast it in your foundry, as alloys of this character are difficult to make unless the exact formula used by the manufacturers is known. If the metal is bought as ingot from the makers, they will be interested in your success in making the sand castings and will freely extend counsel that will enable the work to be carried out in a satisfactory manner. A fair imitation can be made by adding iron and lead, the latter in small quantity to low grade nickel silver scrap. As nickel is expensive the alloy is not cheap.

Phosphorus Detrimental

We recently melted 250 pounds of good scrap brass in an oil-fired, open-flame furnace. We charged 4 pounds of boronic copper No. 3 with the metal and shortly before pouring we added 5 pounds of 15 per cent phosphor copper. The melting was done under a flux of salt, borax and charcoal and the metal was poured very hot. The castings showed a very poor crystallization and when examined under a strong glass showed many hair cracks. Can you give us an idea of what caused this trouble?

The poor crystallization, and most probably the hair cracks also were caused by over deoxidizing the alloy. As scrap was used entirely, it was no doubt largely composed of red brass which is an alloy of copper with varying percentages of tin, zinc and lead. This mixture will not stand much phosphorous and as the boronic copper contains phosphorus there was no need for the phosphor copper.

It would be advisable to omit the phosphor copper entirely, in future heats, or to omit the other deoxidizer and simply add just before pouring at the very most, only 0.25 per cent of 15 per cent phosphor copper. If this change fails to correct the difficulty, omit all phosphorous deoxidizers and use instead 0.25 per cent of 30 per cent manganese copper, *A* grade. The manganese copper can be used in amounts up to 0.5 per cent, but the increase over 0.25 per cent should be made with caution; the fracture being the guide.

Aluminum Alloy Numbers

We wish to be advised as to the meaning of the various numbers by which aluminum is known, such as No. 12 aluminum and No. 31, or No. 80 aluminum?

The term No. 12 alloy aluminum is well established as the trade name for an alloy containing copper in the proportion of about 8 per cent. The term No. 31 also is often applied to an alloy consisting of 3 per cent copper; 15 per cent zinc, and 82 per cent aluminum. The term No. 80 aluminum is never heard and when this term is used, it should always be accompanied by the chemical specification of the alloy.

Castings for Ship Construction-XVIII

Two Part Built-Up Box is the Best Medium For Molding Cast-Steel Stern Frames — Elevating the Box at One End Facilitates Pouring and Feeding Operations

BY BEN SHAW AND JAMES EDGAR

THE type of stern frame shown in the accompanying illustration is generally adapted to freight steamers. The tendency is toward simplicity of design without sacrificing the requisite strength. The desire for economy, not only in the labor necessary to construct the vessel, but in changes which occur through damage after the vessel has left the builder's hands, has resulted in more attention being paid to the design of parts in the structure which are likely to be fractured. Changing the design is not intended primarily to resist possible fracture, though that is of course a consideration. The change is intended rather to reduce the area which may be affected. In this way, when damage does occur the cost of repairing the vessel is reduced to a minimum. Alterations are being made in the general shape of some of the castings used in ship construction and this is particularly true in the case of stern frames. It has been customary to supply large stern frames, comparatively plain in design, for cargo carriers. In some cases the whole stern is formed by one casting.

Experience has proved that when a vessel that is so constructed fractures her stern frame, through collision or grounding, considerable expense is incurred in its replacement, because not infrequently, the nearest port to which the vessel is taken for repairs has not facilities for turning out large steel castings. A smaller type of stern frame gradually is being introduced for this class of vessels.

From an economical point of view the design selected has many advantages. It is not likely to fracture, but should fracture occur it can be replaced more readily. Many iron foundries have extended their plants to include steel casting units and are capable of dealing expeditiously with castings about this size. An increase in the number of possible producers, decreases the time it might be necessary to wait for a suitable casting.

In making one of these castings the time element generally is the most important and care and judgment are necessary to see that quality is not sacrificed to speed. The type illustrated lends itself to the method known as casting on an incline, and since substantial risers are necessary on the boss, the end of the flask nearest the boss is raised. This method requires a two part flask, and if available, a built flask is the best for the purpose.

Some foundrymen prefer a drag deep enough to take in the complete frame. The joint then is made to follow the top contour of the pattern and down to the center of the boss. Such a method increases the cope life considerably and requires additional support to carry the sand. The advantage of the method lies in the fact that the joint usually coincides with the top of the drawbacks necessary to form the channel sections.

Other foundrymen display a preference for flasks in which cope and drag are the same depth. With this type the mold will be in two symmetrical halves, coinciding with the joint of the pattern which has been

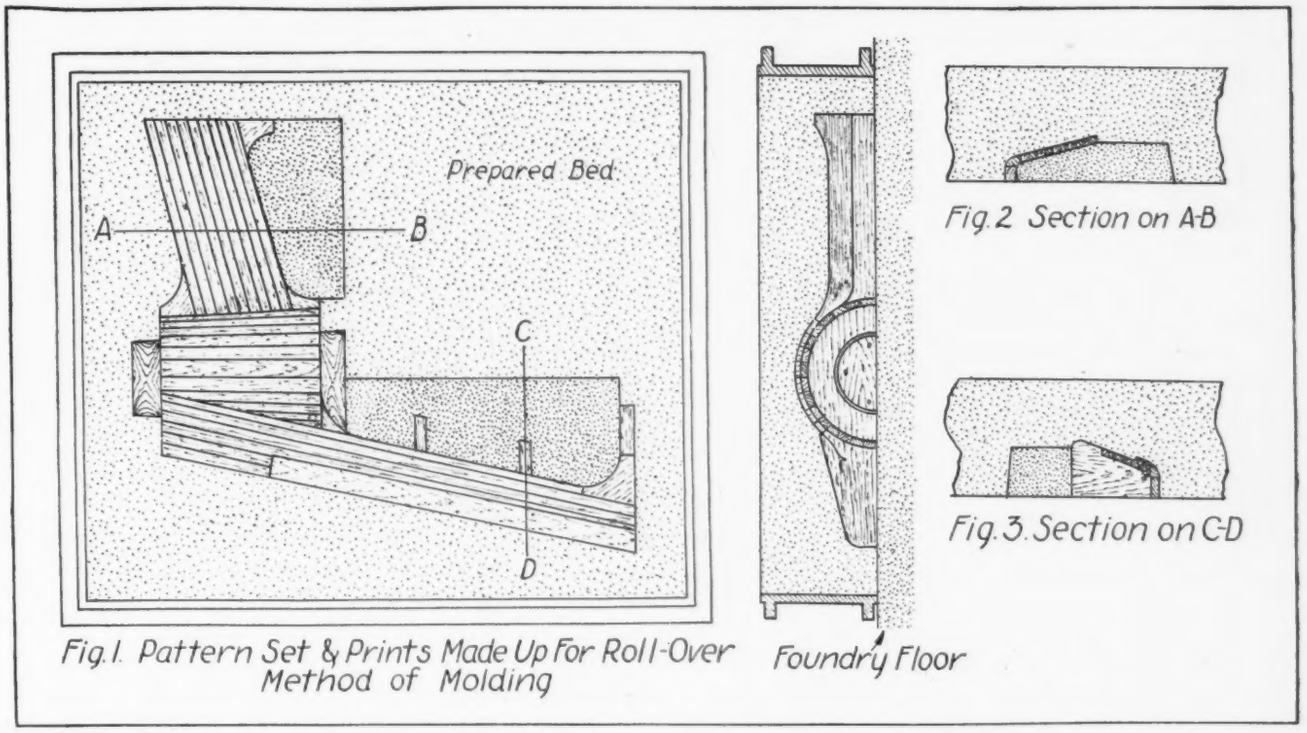


FIG. 1—PATTERN SET AND PRINTS MADE UP FOR ROLLOVER METHOD OF MOLDING FIG. 2—SECTION ON *A-B* FIG. 3—SECTION ON *C-D*

split longitudinally on the center line. This method has the advantage of a level joint, and since it is more easily prepared and requires less labor than the other method it more frequently is resorted to when the necessary flasks are available. Its only disadvantage is that the drawbacks project well above the joint and necessitate considerable care in closing. This objectionable feature may be minimized by the use of long guides.

The practice of bedding such a job in the foundry floor is still prevalent in many foundries. This method necessitates fully as much labor as either of the other methods, a greater number of risers will be found necessary and the only advantage it has is that no drag flasks will be needed. When facilities are available and the size and character of the work permits, it is better to use a two part flask so that the casting may be poured on an incline. That is the method which will be described.

Using a Two Part Flask

A level bed is prepared on the foundry floor upon which the drag half of the pattern is laid, joint side down, as shown in Fig. 1. This tends to stabilize the pattern, especially if it is of a fragile nature. The drag frame of the flask is set in position to locate and determine the shape of the bars which will be required. It then is removed temporarily and while the bars are being sorted out or prepared, sand prints may be formed for the drawbacks. Bricks are used to build up the shape, the webs are packed to resist the ramming, and the prints shaped with floor sand. Wet parting sand is spread over the prints to form a parting. The shape of these prints corresponds to what dry sand core prints would be if dry sand cores were used; that is, they follow the inside contour of the pattern web as shown in the sections *AB* and *CD*, Fig. 3. The pattern made up with the improved prints is shown in Fig. 1. The inside boss

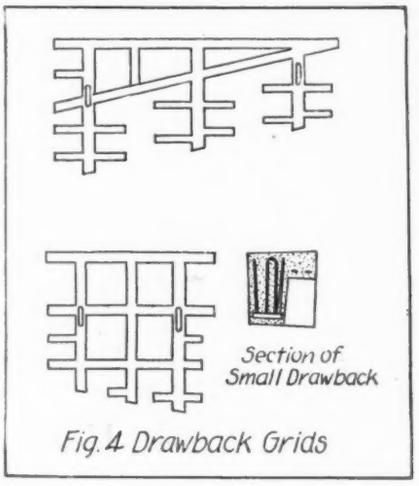


FIG. 4—DRAWBACK GRIDS

print which is shown should be partially covered with the sand print. The elevation shown in Fig. 1 illustrates the relationship between the flask part and the pattern with the bars removed. After the bars have been set in and bolted the ramming may be started.

The pattern first is covered with a prepared composite and then the flask is filled with successive layers of black or floor sand, each layer being rammed in turn until the box is filled. No gaggers or hooks will be needed, providing the lower edges of the bars have been cut out to conform to the shape of the pattern and about ¾-inch clearance allowed. The face of the mold may be nailed after the pattern has been withdrawn but this precaution is taken only to stiffen the skin.

Preparing the Drawbacks

When the box has been rammed and leveled off a number of screw-eyes which have been inserted in the top face of the pattern at suitable points, are secured with short rods and wedges across the tops of the bars, and the whole is rolled over. The screws are removed before the box is lowered, back down, upon a sand bed. The improvised prints, of course, will remain on the floor. They are of no further use. The print impressions left in the box are tapered and sleeked and a coating of parting sand applied. They then are ready to receive the sand for the drawbacks. Before commencing to ram sand in the drawbacks it is advisable to try the grids with the top or cope half of the pattern in position so that afterward they may be set properly. Suitable forms of grids for this purpose are shown in Fig. 4. Ordinary prods or gaggers may form an integral part of the exterior edge but it is better practice to cast pieces of wrought iron or steel rods in those parts of the grids which support the sand near the pattern. They are more pliable and may be bent to shape when forming the cores or drawbacks; they also offer less resistance to the crushing of the cores when the metal in the mold contracts.

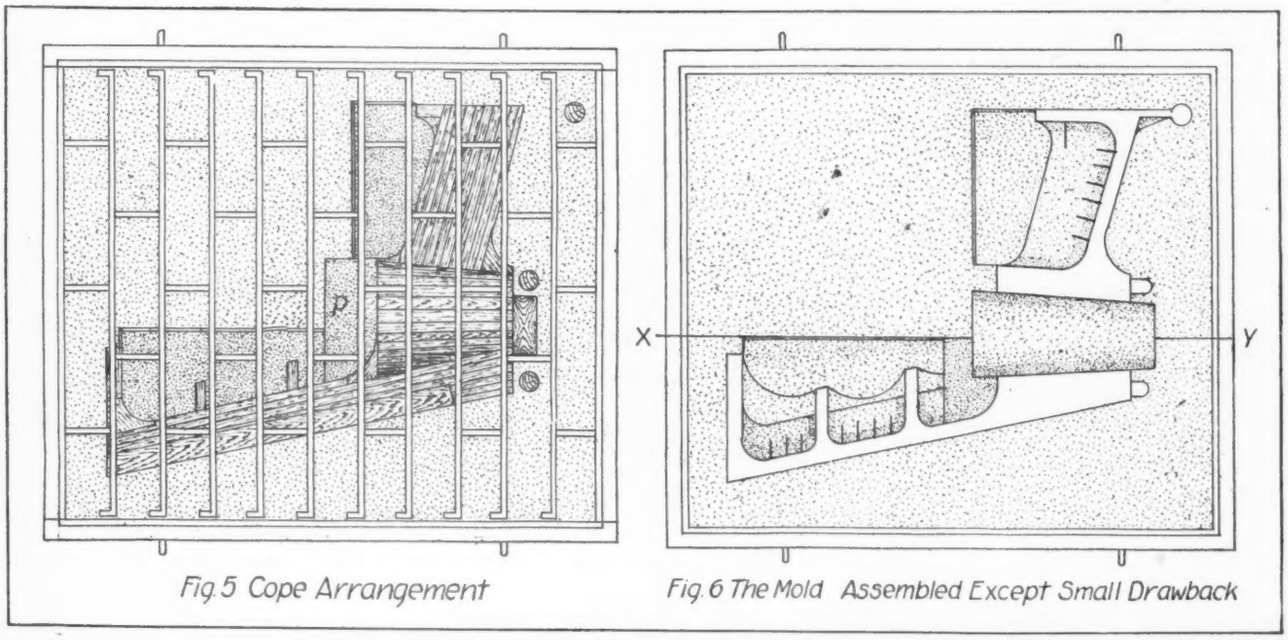


FIG. 5—COPE ARRANGEMENT FIG. 6—THE MOLD ASSEMBLED EXCEPT THE SMALL DRAWBACK

In designing the necessary grids this crushing action must be kept in mind and a generous margin of clearance allowed between the grids and the casting.

After the grids have been fitted and the rods all bent to suit, the cope half of the pattern is removed and the grids taken out. A thickness of wet composite is spread on the bottom of the drawback print and the grids replaced. The shell of the drawbacks is formed with composite about 2½ inches thick while the inside is filled with rammed ashes. When they are nearly up to the complete shape the top half of the pattern is bedded on. A small drawback is required over the top half of the boss core print cutting through the long drawback to the joint as indicated at *P*, Fig. 5. This arrangement is necessary to allow the center core to be lowered into position when closing the mold. The small drawback may be made to follow the contour of the boss and the tops of the other two drawbacks with which it comes in contact, and then graduated off to reduce the surface likely to interfere with a safe lift of the cope box.

When all the drawbacks are made up and allowed to stiffen, the cover, or cope flask is set on, and the work of ramming proceeds. Gate sticks are set near the junction of the rudder post and also two substantial risers on the boss. These should be given a rake so that they will be practically vertical when the job is canted for casting. After the cope has been rammed the same practice is resorted to in securing the top half of the pattern temporarily to the box, as was followed in the case of the drag. The ribs and the inside center core print are disengaged from the main pattern during the ramming process and remain in the drag when the cope, with the attached half pattern, is lifted off.

When the lift has been accomplished and the box rolled over, the cope half of the pattern is withdrawn and the mold is finished. Some patching probably will be necessary on the drawbacks left in the drag, but a clean withdrawal should be obtained from the pattern sections. The removal of the drawbacks carrying loose sections of the pattern will clear the drag half of the pattern, which then may be taken out of the mold.

When the mold is finished and all sharp corners of sand rounded off, the whole job may be transferred to the drying oven. It is well, however, to depress the joint surrounding the mold, and also cut out a number of contraction webs while the sand is green. A riser may be brought off from the uppermost point of the boss, but since the risers are connected with each other, a depression at the highest point is made in the cope, so that any gases that may be trapped will not interfere with the soundness of the casting.

It is customary to prepare the runner and riser basins and the center core while the mold and drawbacks are drying. The center core is usually made on a horizontal spindle in the manner described in previous articles. Iron rods are wired on before the last coat of composite is applied, to reinforce the core.

When a job like this is cast in the position indicated and the runners and risers are bunched close together, a single trough is frequently used. It consists usually of a rectangular plate with a slot in the center to take the gates and having a number of lugs on the outside for attaching the crane chains. A row of gaggers standing up around the edge serve to reinforce the sand. The runner and riser basins are shaped inside of these gaggers and are independent of each other. Bricks and composite are used to form the shape. Both center core and runner basin are dried.

When all the parts are dried and thoroughly cleaned, a good application of silica paint is given those parts which come into contact with the molten metal. The whole mold is then thoroughly dried. When taken out of the oven the second time the remainder of the mold is assembled. The two larger drawbacks are lowered into their respective positions, a couple of chaplets, equal in thickness to the required web being nailed to the bottom of the mold to support the overhang. The holes around the staples then are made up and dried with a hot brick. The center core is placed next, the top half of the small end being rubbed

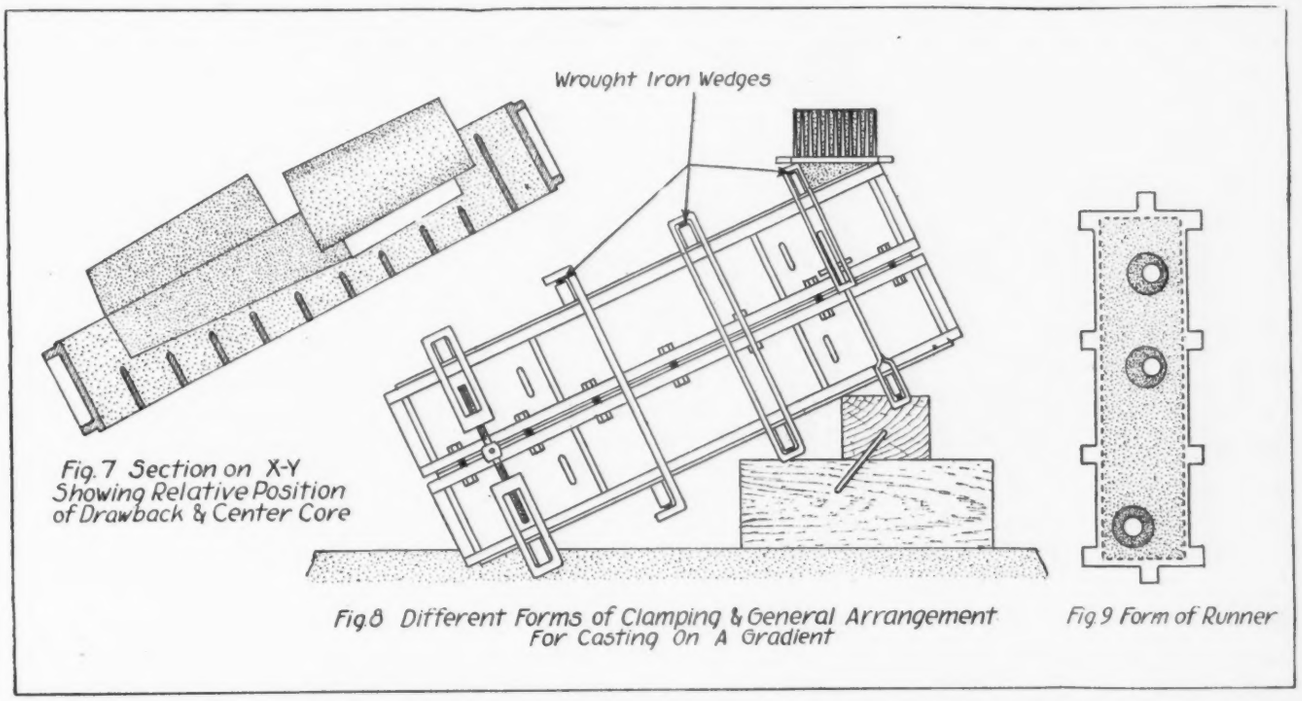

Wrought Iron Wedges
Fig. 7 Section on X-Y Showing Relative Position of Drawback & Center Core
Fig. 8 Different Forms of Clamping & General Arrangement For Casting On A Gradient
Fig. 9 Form of Runner

FIG. 7—SECTION ON *X-Y* SHOWING RELATIVE POSITION OF DRAWBACK AND CENTER CORE FIG. 8—DIFFERENT FORMS OF CLAMPS AND GENERAL ARRANGEMENT FOR POURING CASTING ON AN INCLINE FIG. 9—FORM OF RUNNER

back to allow clearance for the final closing of the mold. A belt sling is a great convenience in handling cores of this description.

The last part to be lowered in is the small drawback covering the inside end of the center core. A plan of the mold assembled, except for this small covering core, is shown in Fig. 6. The contraction webs are shown by thick lines and the shape of a thickened fin is shown in contact with the webs of the frame and the divisional brackets. A section of the assembled mold is shown in Fig. 7, showing the clearance necessary on the parts projecting above the joint to prevent any possibility of crushing when the cope part of the mold engages them. A section of the small drawback also is shown in this illustration.

There are a wide variety of ways in use for securely fastening a completed mold of this character. The method shown in Fig. 8 is reliable and provides ample safeguard against the pressure exerted by the molten metal. A number of clamps are illustrated, adjustable and otherwise. It will be noted that the clamp on the lower end has a screw adjustment and is tightened by a *tommy* bar; the clamp on the upper end is tightened by wedges. The other clamps illustrated require packing at the bottom and wrought iron wedges at the top. In addition to the clamps, the flasks are bolted together at the joint as shown.

When the flasks have been firmly bolted and clamped, the end containing the boss is elevated and blocked up as shown in Fig. 8. A composite bed is prepared for the runner and riser trough. A plan of this is shown in Fig. 9. The preparation of this bed requires considerable care. Gate sticks are set in the existing openings, completely filling them to prevent any sand from falling into the gates. After the bed has been made up the prepared trough is lowered on to it so that the holes in both parts coincide. The inside junction is made up and coated with silica paint. Red hot plugs are used for drying these wet patches, they can be left in until just previous to pouring the metal. When the casting has been poured it is fed by way of the two headers.

It is necessary to devote considerable attention to easing a casting of this description. The flanges connecting the keel plate and the rudder post are large and at right angles to the direction of the strain set up when the metal is cooling. For this reason, the drawbacks must yield to the pressure. Few of these drawback grids offer suitable facilities for applying the wedged bar which holds the parts together until the wedge is withdrawn, a practice which is efficatious in relieving the strain in some types of steel castings. In this case access must be obtained to relieve the grids by hand. It is not necessary to wait until it is convenient to lift the cope flask. The drawbacks may be located from the outside. The sand and some of the short bars may be removed, in order to get at the drawbacks and ease them so that they will offer as little resistance as possible to the contraction of the casting.

Notwithstanding the care bestowed and the precautions observed in easing and slacking off the rigging around a casting of this description, internal strains will exist. However, an effort should be made to minimize the strain so that its amount does not exceed the ability of the metal to resist it. By careful attention to annealing, practically all these internal strains can be eliminated.

Gray-Iron Mixtures For Automobile Pistons

By H. E. Diller

Question—We would like to know a good mixture of iron for automobile pistons, which will give a good clean casting that can be machined easily.

Answer—We would recommend a mixture for automobile pistons castings made up of 50 per cent pig iron, 38 per cent clean cast-iron scrap and sprues, and 12 per cent steel scrap. The steel scrap should not be thinner in section than ¼-inch and preferably not heavier than 1 inch. If the steel is too light it will oxidize and if too heavy it will not melt entirely while passing through the melting zone of the cupola. Should steel plate be used it should be cut into small pieces so as not to obstruct the course of the air through the cupola.

The pig iron and scrap should be of such a composition as to give an iron containing 1.75 to 2.00 per cent silicon; 0.150 to 0.250 per cent phosphorus, and 0.50 to 0.80 per cent manganese. Sulphur should be kept as low as practicable and should not run above 0.100 per cent if it is possible to keep it under this figure. Suitable pig iron can be obtained by using either the regular pig iron used for malleable castings, known as malleable bessemer pig iron, or the straight bessemer pig iron may be used. The phosphorus in the malleable bessemer pig iron will not be over 0.200 per cent, and in the bessemer pig iron it will be below 0.100 per cent. The sulphur should be under 0.05 per cent in both irons. It will be necessary to specify the amount of silicon desired in each order according to the amount required to bring the cupola iron to the proper composition.

After the right mixture is secured it is essential to see that the melting is carried on correctly. Care should be taken to have the bed of coke high enough and to see that there is sufficient coke between the charges. Commencing with the third charge, a flux should be used consisting of 40 pounds of limestone and 2 pounds of fluor spar to a ton of metal.

While all the details of mixing and melting the iron may be carried on perfectly, yet the castings will not be free from defects unless the casting is gated and poured properly. Often defects are blamed on the iron which are due to the methods of molding or of handling the iron after it is in the ladle.

Russia Rich in Graphite

Extensive deposits of graphite exist in northwestern Siberia on the left bank of the River Kureika near its junction with the River Yenisei, 90 miles from the mouth of the latter river. The graphite area forms a horizontal plateau and contains two layers of graphite, which is of a solid steel-gray color, soft, and of an excellent quality.

The graphite mines of Siberia were discovered in 1859 by the explorer Sidoroff, who sent samples to Russian and foreign laboratories for analyses. These analyses gave the following chemical composition: 89.51 per cent carbon, 0.60 per cent hydrogen, and 9.89 per cent residue. These analyses were confirmed in 1907. The carbon constituent is said to be superior in quality to that found in graphites in some other parts of the world. The graphite is not inflammable and is quite plastic.

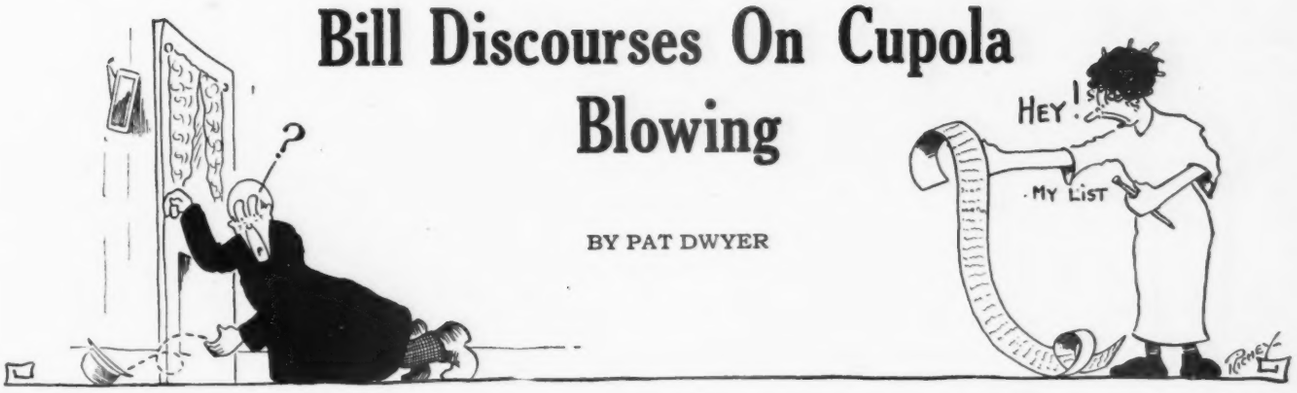
At present it is practicable to ship the graphite only in the summer months by sea from the Yenisei river through the Arctic ocean. It is believed that in the future the graphites from these mines will supply Russian demands and that large quantities will be available for export.

The chief sources of graphite now are Ceylon, Bohemia, Germany, France and the United States. The annual world production has been approximately 120,000 short tons.

The Tabor Mfg. Co., Philadelphia, recently moved into its new plant at State road and Devereaux street, where it is erecting an addition 100 x 108 feet. The company will be in the market for machine tools in the near future and is now preparing a list. H. W. Brown is secretary.

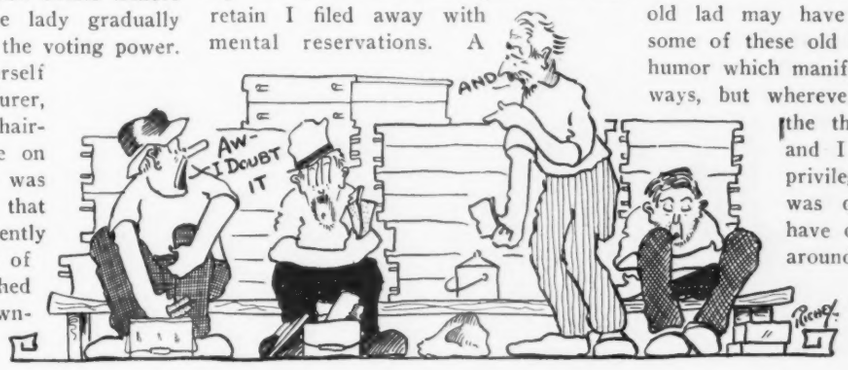
Bill Discourses On Cupola Blowing

BY PAT DWYER



SEVERAL years ago I helped to incorporate a company with a certain charming lady as a party of the second part. It was a kind of a gentleman's agreement, if you know what I mean, there was no regular board of directors or officers appointed. It was one of those agreements where it is tacitly understood that all mine is your's and all your's is your own. New members were taken in from time to time but on account of a legal technicality which denies minors the right to vote the lady gradually assumed to herself all the voting power. She also appointed herself to the position of treasurer, general manager and chairman of the committee on ways and means. It was in her official capacity that she approached me recently and handed me a list of things which she wished me to purchase downtown. I did not argue the point, but sallied forth. In the course of my perambulations, I met Bill bent on a similar errand. We combined forces and finally wound up in a restaurant with the laudable intention of absorbing some nourishment before heading for home. Our conversation dealt with children, their doings and sayings. I said it was a constant marvel to me where they got the inspiration for some of the questions they ask.

"Children don't ask all the funny questions," said Bill. "Listen! I worked in a shop in Newark, N. J., one time about 20 years ago. As the hero says in the melodrama, 'I won't mention no names,' but there was the front shop, the old shop and the new shop. It was popularly reported in foundry circles that they put the shiboleth test to all candidates for employment. If you could not say 'Aye' with the proper intonation when the shop committee put the question, 'Hae ye a car'r'r'd wi' ye?' you might just as well not go to work. It may have been that my accent was in my favor, or perhaps there was no truth in the report as I found them a pretty decent crowd of men to work with and I had the pleasure of quitting voluntarily when I felt the call to start on the southern migration. They made some nice work there, but of course nothing like what they were accustomed to make along Clydebank. Being young and polite in those days of course I listened patiently to all that was told me. However, I let most of it in through one ear and out through my elbow, and the small portion I did retain I filed away with mental reservations. A



SOME ONE STARTED A DISCUSSION ON BLOWERS

crowd of us were sittting one day on a long bottom board with our backs against a pile of flasks. We had just finished a dainty and *recherche* lunch, table-de-foundrie style. Some one started a discussion on the problems involved in melting iron and there were certainly some queer theories and experiences brought to light during that noon hour An old loam molder who had learned the trade in Motherwell, but who, like many of his countrymen, had been near ly all over the world since that time contributed the most extraordinary tale. He said that in his young days he often had watched the cupola blower operating in the smoke and grime and dust of the foundry and he was moved to wonder if better work could not be done if the fan were connected to a long pipe which would draw the air supply from outside the shop. He submitted the problem to a well known foundry authority and had received a voluminous reply. He quoted from it freely, using of course the foundry vernacular and as I afterward found out, adding many original embellishments.

"More to draw him out than for any other reason I told him that I doubted the whole story. 'A dinna as A can blame ye lad,' said he, 'but if ye care to ca' at the hoose the nicht A think A can convince ye—an' A have the document forby ta prove it.'

"I called at his house that night and he showed me the document. It looked authentic but I had my doubts. The old lad may have written it himself, some of these old birds have a *pawky* humor which manifests itself in curious ways, but wherever he had found it, the thing appealed to me and I asked him for the privilege of copying it. He was quite willing and I have carried the document around with me ever since." Bill reached into one of his hip pockets and produced one of those long leather bill folds in which people who are lucky enough to have it carry the long green. He selected several slips of paper and handed them over to me. The first one contained the question, "Does it make any difference if the air for the blower is taken from inside or outside the building?" The reply was as follows:

It would be rather difficult to formulate an opinion on such a peculiar problem without having first hand evidence. We would suggest that one of our experts be sent there to look the situation over and examine your air both inside and outside the shop. If you consider this plan impracticable, you might have a photograph taken showing a section of air entering the fan. In addition you might fill some small receptacle—say a pickle bottle—with samples of air taken at various points in the shop and have the same analyzed by a competent air doctor. We also will appreciate half a dozen micrographs of air sections taken at various temperatures. With these sources of information in our possession we will be in a favorable position to furnish an expert opinion.

There is no doubt in our mind that

under certain circumstances it is preferable to draw the cupola air supply from outside the foundry building. Where the men are addicted to eating garlic for instance, the heavily impregnated air entering the cupola has been known to stampede the pigs and ruin the heat. The same applies to some lines of tobacco and cigarettes to which molders as a rule are addicted. Pigs will stand for much abuse, including an impure air supply and it is difficult to know where to draw the line, but we should say that when they start jumping out through the charging door onto the stage, it is time seriously to consider the advisability of changing the source of the air supply.

Another possible source of contamination for air lies in the amount of elbow grease held in suspension in the foundry atmosphere. Where the intake to the blowers is not carefully guarded, some of this grease finds its way into the cupola with the result that the iron is rendered so slippery that it will not stay in the molds but comes pouring out at the joints of the flasks. This phenomenon usually is referred to as a runout and blamed either on a poor joint or insufficient rigging for holding the mold together. The fact that no molder ever was willing to admit that he was responsible for a runout caused us to investigate the proposition closely some time ago with the result that we are convinced that the elbow grease theory is correct. Perhaps the most important point which merits consideration when discussing cupola air supply in shops which are equipped with pneumatic appliances is the relative position of the blower and the air compressor. It will be apparent to any thinking person that a brand of air suitable for melting iron might be totally unfitted for pneumatic purposes, and vice versa. For metallurgical purposes an air high in oxygen and low in carbon is desired because the fuel furnishes all the carbon necessary for combustion, while for pneumatic purposes the chemical composition makes absolutely no difference. All that is necessary is a light mild brand which will compress readily and not crumple up or splinter. If the blower and the compressor should be placed close together, say in the same building, it is quite within the range of possibility that the air currents might get crossed resulting in confusion. Again, if the two machines are not carefully adjusted to run at the same speed it will not be at all surprising to find that one is robbing the other, or in other words using up more than its fair share of the available air supply.

To offset any possibility of this occurring we recommend that the air inlet for the blower be carried through the north wall of the foundry and the intake for the compressor be led through the south wall. Absolute purity of air being one of the prime requisites for melting iron, it will be necessary to extend the blower inlet for a distance of at least 50 linear feet in a horizontal direction. Here it will terminate in a vertical tank, either round or square, a point which is left to the architect's discretion. This tank should be provided with a hood and a series of filter screens to remove any atmospheric impurities. As a further precaution it might be found advisable to surround the tank with a substantial barb wire fence of standard design, with a sheet of sticky fly paper on the top of each post and a saucer of rough-on-rats at the foot. It long has been recognized in scientific circles that rats and flies are fruitful sources of contagion and we have no doubt that many scabby and pock-marked castings are entirely due to contaminated and germ laden air which has been blown into the cupola and absorbed by the pigs whose pores were naturally open due to the intense heat of the cupola.

BILL BACKS HIS MEMORY WITH WRITTEN FACTS

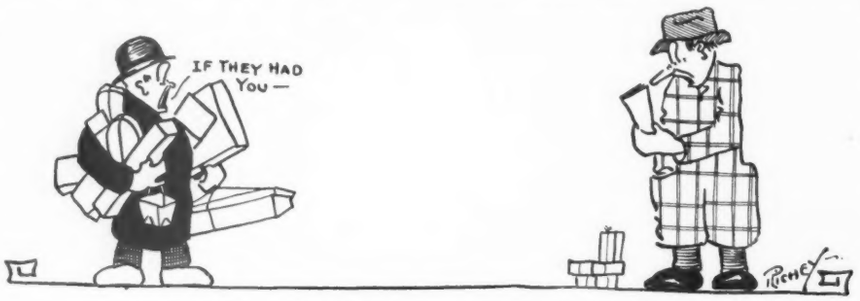
At certain seasons of the year when the rag-weed and goldenrod are blooming, the air is full of pollen dust and profanity. At this time special precautions must be observed in guarding the intake pipe. We strongly recommend that 0.0001 per cent by volume of hay fever specific in granulated form be added to each charge at those times.

An epidemic of sneezing among the pigs is something serious and is generally severe enough to wreck the furnace. Where large quantities of metal are handled, as in blast furnaces, explosion doors are provided for emergencies of this kind. Even with these precautions it is not uncommon during the height of the hay fever season to see the bell blown clear through the hopper.

As we pointed out these are only generalities or an outline of general conditions. Upon receipt of the data to which we have referred viz.: the analyses and micrographs of various samples of air, we can advise as to a definite line of action in your particular case. We are sure you will see the necessity of this course of action on our part. There are so many factors to be considered. For instance: In most countries at the present time there are laws on the statute books guaranteeing each factory and foundry worker a definite number of cubic feet of air a day for his own private consumption. You can easily see what would happen in a close crowded shop a short time after the wind went on. Let us suppose the cupola is rated as having a melting capacity of 10 tons an hour. We know that it requires 33,000 cubic feet of air to melt one ton of iron, therefore in one hour's time the fan would have drawn the enormous quantity of 330,000 cubic feet of air out of the shop. This represents a space 330 x 50 x 20 feet. Just contrast that with the dimensions of the ordinary 10-ton-an-hour foundry and you can see that you would not have a leg to stand on if the employes brought suit for compensation.

I folded the papers and handed them back to Bill. "What do you think of that for a spiel?" said he.

I gathered up my parcels and edged toward the door. "Well Bill," I said, "I know one thing and that is if they had you in the shop they would not need to go to the expense of running an intake pipe through the north wall of the building."



SOME PEOPLE COULD SUPPLY HOT BLAST EASILY

Zirconium in Steel

According to a recent issue of *Le Genie Civil*, zirconium and its alloys dissolve completely when added to molten steel. The ferrozirconium thus obtained possesses an unusual degree of strength which has made it useful for the manufacture of armor or any form of sheet metal for defensive purposes. Armor made of nickel-zirconium steel having a thickness of 0.39 inch has shown the same resistance to the bullet as nickel molybdenum steel of 0.51 inch thickness or chronium steel of 0.63 inch thickness. The zirconium steel which has given the best results has the following composition: Carbon, 0.42 per cent; manganese, 1 per cent; silicon, 1.50 per cent; nickel, 3 per cent; zirconium, 0.34 per cent. It possesses a tensile strength of 250,000 pounds per square inch.

Where Risers Are Used to Advantage

How Feeder Heads Should be Located on Cylinder Castings—Other Features Such as Placing Chaplets, and Methods For Reducing Shrinkage are Discussed

BY M. H. POTTER

RISERS are placed on molds to feed metal to castings; to carry off dirt and slag in the metal and to indicate by the overflow of the metal when the mold has been filled. They also serve as an aid to check the pressure and velocity of the metal at the time of pouring. The number of risers on the mold always should be controlled by and be proportioned to the size of the pouring gates. The risers should be somewhat smaller in area than the pouring gates, as otherwise the pressure on the casting will be insufficient. If a mold is poured with the risers twice the area of the pouring gates, the casting will suffer from lack of metal compression. This is due directly to the insufficient pressure of the metal in the riser. It is axiomatic in foundry work to place the riser on the highest part of the mold. The metal thickness in this part of the casting may not necessarily require the location of a riser at this point, yet it is essential that the riser be located at the highest part of the mold to carry off dirt, slag and other impurities. On the other hand, it also is essential that risers be placed at other points of the mold where the variations from light to heavy sections are abrupt and for the purpose of feeding the heavier sections.

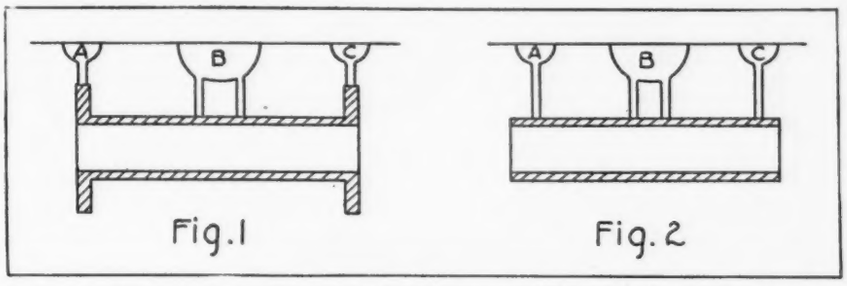
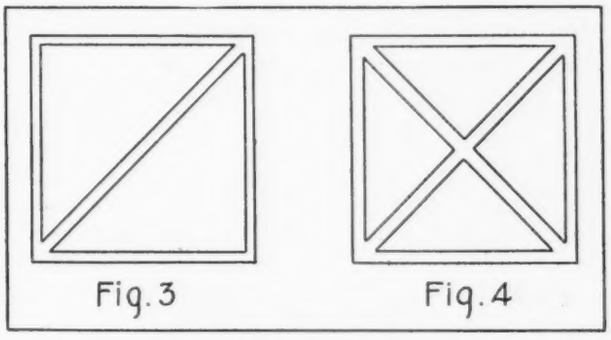


FIG. 1—WHERE RISERS SHOULD BE PLACED OVER A FLANGED COLUMN—THEIR LOCATION ON A PLAIN, CYLINDRICAL CASTING IS SHOWN IN FIG. 2



FIGS. 3 AND 4—IMPROPER AND PROPER METHOD OF PLACING DIAGONAL RIBS ON CASTINGS

In Fig. 1 it will be noted that the riser, *C*, feeds a flange much heavier than the flange for which additional metal is to be provided by the riser, *A*. As this flange is the heaviest part of the casting and if no riser were placed in this part of the mold, the casting undoubtedly would be defective. The riser, *C*, should be oblong in form, should not be more than ½-inch wide or ⅜-inch less in size than the full thickness of the flange.

Fig. 2 is presented for the purpose of contrasting it with Fig. 1, with reference to the use of risers and the necessity for feeding the casting. This casting is of the cylindrical type without flanges. However, in Fig. 1, risers *A* and *C* serve a two-fold purpose, namely, to rid the mold of the dirt, slag, etc., and they also serve to feed metal to the flanges. However, since risers *A* and *C* in Fig. 2 are not located over flanges, it is not essential that risers be used for feeding the mold. However, it is essential to provide these risers to insure clean metal throughout the casting. In pouring a mold of this kind the metal flows around the core and in rising undoubtedly carries with it a certain accumulation of dirt and, therefore, these end risers are essential.

Those who favor the open riser contend that fins must be provided for the escape of air and gas under pressure from the mold and if no suitable exit is provided, scabbing will result. No two molds generate gases exactly alike, due to the variation in the moisture of the sand, temperature of the metal, etc. In pouring a dry sand mold, it is immaterial whether the risers be open or shut. The gases and steam generated in such a mold are nothing as compared with those generated in a mold of a green sand type. For this reason we always have left open the risers in dry sand molds. These provide ample means for the escape of steam, if any is generated, such as from daubing the joints with loam, etc.

For heavy green sand work we favor closed risers. A mold that is ready to receive metal contains air only, but immediately after the molten metal enters, gas is generated. When the mold is filled with gas, the additional gas generated compresses the gas which seeks exit through the vents and the top of the mold. It must be apparent that gas under pressure will sustain the whole interior of the mold, particularly the top which is liable to sag slightly. No such advantage may be gained from open risers as the gases then escape freely through the risers as rapidly as they are generated in the mold. Chaplets are used extensively in foundry work and when applied intelligently do no serious harm to the casting subjected either to steam or water pressure. However, the indiscriminate use of chaplets frequently results in casting losses and it is advisable to add metal at the point where it is necessary to locate chaplets. It is not advisable to place chaplets in any part of the mold if the csating is to be polished. However, this may be overcome by bedding in the studs below the surface of the mold. That part of the chaplet projecting from the face of the casting can be chipped off readily when cleaning and only a lighter metallic spot will be noticeable on the finished surface. Whenever possible, tinned chaplets should be used. It is essential, however, that they be coated with pure tin since a compound of spelter and tin is not nearly so desirable from the foundryman's standpoint. Also, the chaplets should be thoroughly coated,

and if this is not the case, they are liable to rust in storage and such oxidized surfaces will cause blowholes when in contact with molten metal. A casting rusted in this way should be dipped in creosote which will prevent blowing.

Probably no property of iron causes more trouble for foundrymen than that of shrinkage. It is generally assumed that shrinkage occurs in two stages. The first known as the internal, takes place between the time of filling the mold and the solidification of the metal. This causes draws, blowholes, etc. The second stage occupies the period between the complete solidification of the metal and atmospheric temperature. During this period warping, twisting and fracturing of the metal may occur.

The internal effects of shrinkage appear in the form of spongy, porous and weak spots in heavy castings. This effect is intensified at junctions, or where light and heavy sections join, since the cooling here is less rapid than in other parts of the casting. Therefore, the proper proportioning of the thickness of parts of the casting is an important factor in reducing shrinkage to the minimum. Sharp angles should be avoided wherever it is possible to do so. The warping or twisting of castings, due to unequal cooling, is not so much the cause of unequal distribution of the metal as the position of the casting while it is cooling. Some castings have a tendency to twist in cooling, but if turned, this might be overcome. If a U-shaped casting is made bottom-down, it is evident that the bottom side will remain hot longer than the legs of the casting and the legs invariably will be drawn in when cooling. However, if this casting is poured bottom-up, the bottom or heavy section will be exposed to the atmosphere and the legs of the casting will be exposed to the atmosphere and the legs of the casting will not be distorted, due to the more uniform cooling of all parts.

It is well-known that the internal structure of all metals, whether cast or forged, is influenced by the rate of cooling. The habit that some light work molders have of bearing-off castings at certain parts to insure uniformity of cooling, is not generally considered good practice. All such operations, regardless of how carefully they may be performed, are injurious to the casting by shortening or unduly hardening the grain of the metal. If a casting of comparatively uniform section is allowed to cool undisturbed in the flask in which it is poured, it will be found to be of a soft, machinable texture. Experienced molders know that factors to be considered in securing straight castings include the careful consideration of the size and location of gates and risers, position of casting, temper of the sand, etc. For example, if two long castings are poured side by side in one flask, one side of each casting will be warped. This is due to the fact that the two inside faces of the castings require longer to cool than the outside faces.

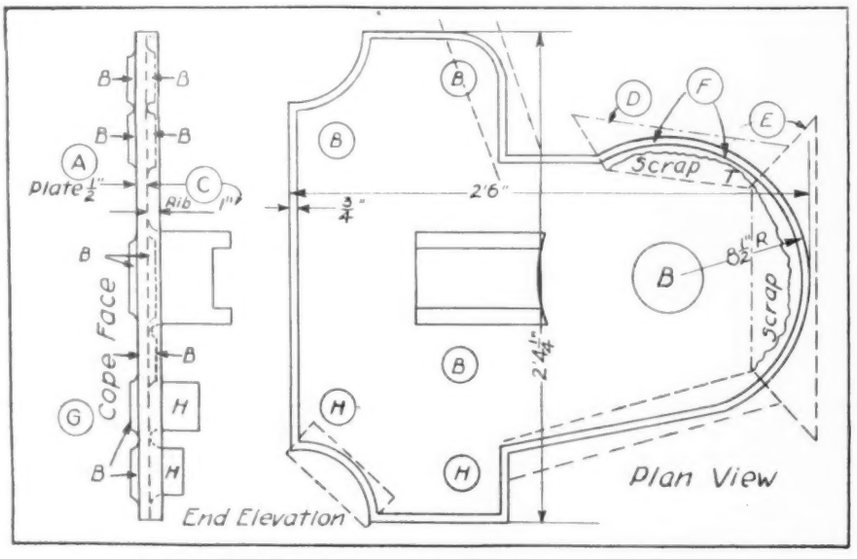
Fig. 3 illustrates a diagonal rib on a square casting. This is sure to result in a badly warped, unduly strained, if not in an actually broken casting. The placing of the ribs as shown in Fig. 4, will prove to be more satisfactory although the arrangements of these ribs in both Figs. 3 and 4 are objectionable. However, in Fig. 4, the strain is better distributed by the opposing action of shrinkage set up by the additional diagonal rib. While the ribs, as shown in Fig. 4, will have a tendency to balance the strain, a casting so designed cannot possibly have equality of shrinkage. In designing castings, it is essential that the parts be so proportioned that uniform shrinkage is assured.

Making a Pattern For an Oil Drip Pan

BY M. E. DUGGAN

IT IS said that there is a right way and a wrong way for doing everything. But the longer I remain at the trade the more I am inclined to believe that while there may be only one right way of making a pattern, many wrong ones are also practiced. Two methods were employed in making two patterns similar to the one shown in the illustration. The first method is used by many patternmakers on work of a like character. It is long and round about and involves unnecessary time, labor and expense; the second method reduces the process to the essentials and is correspondingly economical. The illustration shows a pattern for a combination base and drip pan for a special machine. There is much more to the casting, but I am illustrating only the parts that are of interest in the making of the pattern. In the first method referred to, the stock for the plate *A* was passed through the planer and dressed down to ½ inch in thickness. The edges were jointed and boards, sufficiently wide, were glued together to make the plate. Then the plate was dressed by hand to the exact ½ inch in thickness, after which it was gone over with both coarse and fine sandpaper.

The operation of dressing the plate by hand was unnecessary, and applying sandpaper to an unfinished pattern is contrary to either good sense or good practice. The abrasive from the sandpaper imbeds itself in the wood and is detrimental to edge tools. The plate was next cut to the required shape. Stock for the rib around the edge was dressed to 1 inch, the required thickness. Each section of the rib was marked and sawed out separately and then fastened to the plate with glue and nails. The rib was then finished and draft-



PLAN AND END ELEVATION OF PATTERN FOR COMBINATION BASE AND DRIP PAN

out by hand with chisel and gouge. The bosses *B* were loosely fastened to the cope face of the pattern. This was unnecessary as they were very thin and had plenty of draft.

A short time after the first machine was placed in operation another one was built. It was designed like the first one but was larger. This necessitated a new pattern.

In making the second pattern the stock for the plate was run through the planer down to ½ inch in thickness, the edges jointed, and the boards glued together. The shape of the plate was laid out on this board. A plank was then dressed to 1 inch to provide stock for the ribs. Pieces as shown at *D* and *E* were cut from this plank to make a rib all around the pattern. These pieces were loosely fastened with wire nails to the side of the plate opposite to the side on which the marking was done. This is

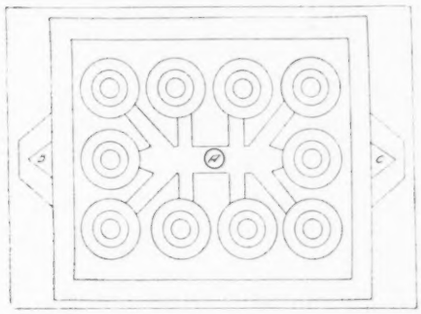


FIG. 1—PATTERN PLATE FOR MAKING O. G. CAST IRON WASHERS

quite contrary to general pattern shop practice but is really the best way to make plate patterns having ribs on edges. The plate with the short sections attached temporarily was then taken to the band saw. It was set on the table of the saw with the rib side down and cut to the outline all around. Brads were driven through the middle of the ribs and part way into the plate as indicated at *F* in piece *D*. Each piece was in turn treated this way. The location of the ribs was plainly marked on the top face of the stock

The width of the ribs, ¾ inch, was marked on both the ribs and the plate, before removing from the plate to prevent a possible mistake in the gaging or sawing. The ribs were then removed, with the wire nails left in them, and taken to the band saw where they were cut with an easy bevel to insure a good draw from the sand. Glue was applied to the joint face and the ribs returned and securely fastened in their places with wire nails. The pattern was then given a sandpaper finish, that is, after the pattern was made and not when it was half finished as is very often done by apprentices and journeymen young at the trade.

If apprentice boys were taught the short, practical ways of doing jobs, instead of the long round about ways which waste time and labor and so run up the expense, their services would be more appreciated and they would become better journeymen.

Making Cast Iron Washers in Quantity

By Pat Dwyer

Question.—We are interested in the manufacture of cast-iron washers and would appreciate a detailed account of the most modern and economical way of making them.

Answer.—For the purpose of illustration we will assume that you are going to put one man on the job of making ¾-inch O. G. cast-iron washers. You may then regard the following description as applying to a unit and fit up as many more as you please. A ¾-inch washer is 3 inches in diameter, therefore a 12 x 14-inch snap flask will accommodate 10 patterns.

The first step is to make a wooden pattern and cast 10 pieces from it either in white metal or aluminum. Of course you are not limited to the use of these two metals but they are the best in our judgment. Place the castings in a lathe and finish them true and smooth, taking particular care to see that the holes are true and nicely tapered. Then prepare a plate 14 x 16 inches, the same dimensions as the outside of the snap flask, with a lug at each end. See *B* and *C* in accompanying illustration, Fig. 1. Lay the part of the snap containing the guide holes on the plate and mark through them. Drill holes at these places and finish them carefully to the triangular shape of the guides. This is an important point; the holes must be loose enough to slip up and down on the guides easily, but there must be no lateral play. Just a nice loose sliding fit.

Having finished the guide holes, lay the plate on the bench, scribe a center line on it and arrange the patterns to the best advantage on both sides of the line. In this case the patterns will be 1 inch away from the sides of the flask, ½-inch away from the ends and about ¼-inch from each other.

Take the plate and patterns to a drill and drill two ¼-inch holes right through each pattern and plate. Mark each pattern individually so it can be located again. Tap the holes and screw the patterns firmly to the plate; or you may countersink the holes and rivet the patterns in their places.

The pattern plate may be aluminum or white metal ½-inch thick, or it may be a piece of ¼-inch steel plate; in either case it must be flat and straight.

A wooden pattern for a gate is then prepared. It is carefully fitted so that it touches each of the patterns. The main branch is 1¼ inches wide by ¾-inch thick and branches are ¾-inch wide by ½-inch thick. A casting is made off this pattern either in white metal or brass and after it is finished nice and smooth it is fitted into place on the plate and screwed or riveted into place in the same manner as the patterns. Before attaching the gate to the plate a ⅞-inch hole is drilled through it as shown at *A* in the accompanying illustration, the purpose of which will be referred to later.

In order to make molds with this pattern, the molder lays the plate on the table of his machine, pattern side up, and sets on that part of the flask

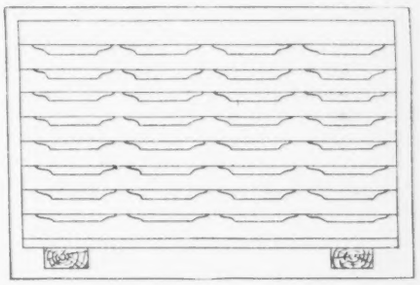


FIG. 2—MOLDS STACKED FOR POURING. THE BOTTOM FACE OF EACH DRAG SERVES AS A COPE FOR THE PRECEDING MOLD

containing the pins or guides. He then drops in a thin iron band which hugs the inside of the flask closely. The purpose of this band is to prevent the mold from bursting during the operation of pouring the iron. He riddles in some sand, presses the sand in the holes in the patterns with his index finger, then fills the flask with sand and squeezes it. The sequence of operations then are: He puts on his bottom board (this only applies to the first one), rolls the mold over, raps the pattern plate and lifts it off, carries the mold to the front of his floor, removes the snap, carries it back to his machine and starts another one.

In the second and succeeding ones a short gate pin is set up in the recess previously referred to in the horizontal gate. This leaves an opening through each body of sand and forms a continuous upright gate from top to bottom.

As may be seen by referring to the sketch, Fig. 2, there are, properly speaking, no copes used, the bottom face of each drag acting as a cover for the preceding mold.

If you do not care to fit up the patterns yourself, any of the molding machine makers will supply you.

THE FOUNDRY

A semimonthly journal devoted to all branches of the foundry trade

Published by

The Penton Publishing Co.

Penton Building, CLEVELAND

BRANCH OFFICES

BOSTON.....426 Old South Bldg.
CHICAGO.....1147 Peoples Gas Bldg.
CINCINNATI.501-505 Commercial Tribune Bldg.
NEW YORK.....2203-2206 St. Paul Bldg.
PITTSBURGH.....2148-49 Oliver Bldg.
WASHINGTON, D. C.....40 Metzerott Bldg.

FOREIGN OFFICES

BIRMINGHAM, ENG.....Prince's Chambers
LONDON, ENG 16 Regent St., Dorland House

Cable address, IROTRAPEN, London.

SUBSCRIPTION

United States and Mexico.....$2.00 a year
Canada.....$3.00 a year
Great Britain and other Foreign Countries.....$4.00 a year
Single Copies.....15 cents

Copies published three months or more previous to date of current issue, 25 cents each

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulation and Associated Business Papers Incorporated

ENTERED AT THE POST OFFICE AT CLEVELAND AS SECOND CLASS MATTER

Copyright 1920 by the Penton Publishing Co.

Contents

	Page
Making Rubber Mold Castings	43
Instructions Sent Out in Bulletin Form	48
Checking Mistakes in Stock Records	49
Conveyors Speed Foundry's Work	51
Acids For Pickling	58
Training Men for Foundry Duties	59
Organizes New Foundry	61
Completes New Factory	61
Making Manganese Steel by the Open-Hearth Process	63
How Tie Rods for Ore Docks Were Welded	66
Venting Method Provides Free Passage	66
Melting Brass in a Gray Iron Shop	67
Forms Sales Corporation	69
Bureau of Standrds Will Promote Safety	69
Building Large Foundry	69
Mines Domestic Graphite	69
A Correction	69
How and Why in Brass Founding	70
Shrinkage Cracks in Chill-cast Aluminum	70
Nonshrinking Alloys	70
What is Aterite?	70
Phosphorus Detrimental	70
Aluminum Alloy Numbers	70
Castings for Ship Construction—XVIII	71
Gray-Iron Mixtures for Automobile Pistons	74
Russia Rich in Graphite	74
Bill Discourses on Cupola Blowing	75
Where Risers are used to Advantage	77
Making a Pattern for an Oil Drip Pan	78
Making Cast-iron Washers on Quantity Basis	79
Evolution in Casting Plants	80
Attention to Costs	80
Trade Outlook in the Foundry Industry	81
Comings and Goings of Foundrymen	82
Testing Society to Meet in Asbury Park	83
Acquires East St. Louis Malleable Plant	83
British Products Shown in Brazil	83
Grinnell Co., Inc., Assumes Extinguisher Lines	83
Starts Construction of New Building	83
What the Foundries are Doing	83
New Trade Publications	84

Evolution in Casting Plants

ONE outstanding feature has characterized the many casting manufacturing plants which have been constructed during the year just past. The modern foundry as represented by the many built in 1919 is a thoroughly efficient factory building, erected and equipped with the idea of adaptability paramount. In times gone by, any sort of second hand structure has been deemed satisfactory for a foundry. The only requirements in foundries of the past century were a roof, some sections of side walls and a floor; anything in fact which would surround and partially house some sand heaps, a few flasks and melting equipment. All routing of work was fitted to the existing structure irrespective of all questions of efficiency. This of course does not represent all the older foundries. However, the exception serves only to prove the rule. The entire basis of plant design was revised and the building was made a part of and tributary to the general manufacturing scheme during the tremendous building period of 1919. Considerations of efficiency governed the layout of buildings. Human conservation, health and comfort ruled in the design of heating, lighting and ventilating features in more recent establishments. Sound engineering principles formed the groundwork both for the buildings and equipment. This great stride in foundry construction has not been the result of an immediate change. It has been a development of many years, but has been more strongly apparent in the many structures erected recently. The free interchange of ideas fostered by technical and commercial organizations has aided greatly in bringing better principles of plant design to the foundry industry.

Attention to Costs

WHEN work is scarce, labor is plentiful and materials are cheap, the castings manufacturer scans every inquiry carefully. He figures his costs closely with a watchful attention. He competes for every job with others confronted by similar problems of keeping their plants engaged to carry overhead and interest changes. Foundrymen have known such times within the past few years and many have made a careful study of the cost problem under pressure of slack times. With the start of 1920 conditions are changed. Work is plentiful while both material and labor are scarce and high. With few exceptions, most commercial foundries find an abundance of inquiries from customers who appreciate the general conditions and are willing to pay higher prices. Expansion is the order of the day. Now as never before is the need for an adequate foundry cost system imperative. Any system which is not sufficiently elastic to permit each estimate to care for constantly advancing prices should be discarded. All fixed percentages, added to care for overhead, depreciation and interest, should be revamped so that each job may carry its fair proportion of the rising prices. Past production figures which are used as a basis for present estimates should be scrutinized and checked. The foundryman who today makes costs his study is best equipped to meet any possible reaction which may follow the unprecedented expansion of the present day.

THE FOUNDRY DATA SHEET, JANUARY 15, 1920
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

DATA ON CHIMNEY DESIGN

By J. G. Mingle

Correction for Velocity Losses

The theoretical intensity of draft is correct only when there is no flow or circulation. When the gases are flowing, the theoretical value is decreased by the losses due to velocity and friction within the chimney. This difference is called the available draft.

$$D' = KH - (h_v + h_f)$$

where D' = available draft in inches of water,

h_f = loss due to friction in inches of water,

h_v = loss due to velocity in inches of water.

The loss of draft due to velocity within the chimney is determined by the formula

$$h_v = 0.1184 \frac{V^2}{T_c}$$

where V = mean velocity of chimney gases in feet per second.

Fig. 2 gives the values of h_v for various chimney gas temperatures with the different mean velocities as shown.

(*Continued on Data Sheet No.* 318)

DATA ON CHIMNEY DESIGN

By J. G. Mingle

(*Continued from Data Sheet No.* 317)

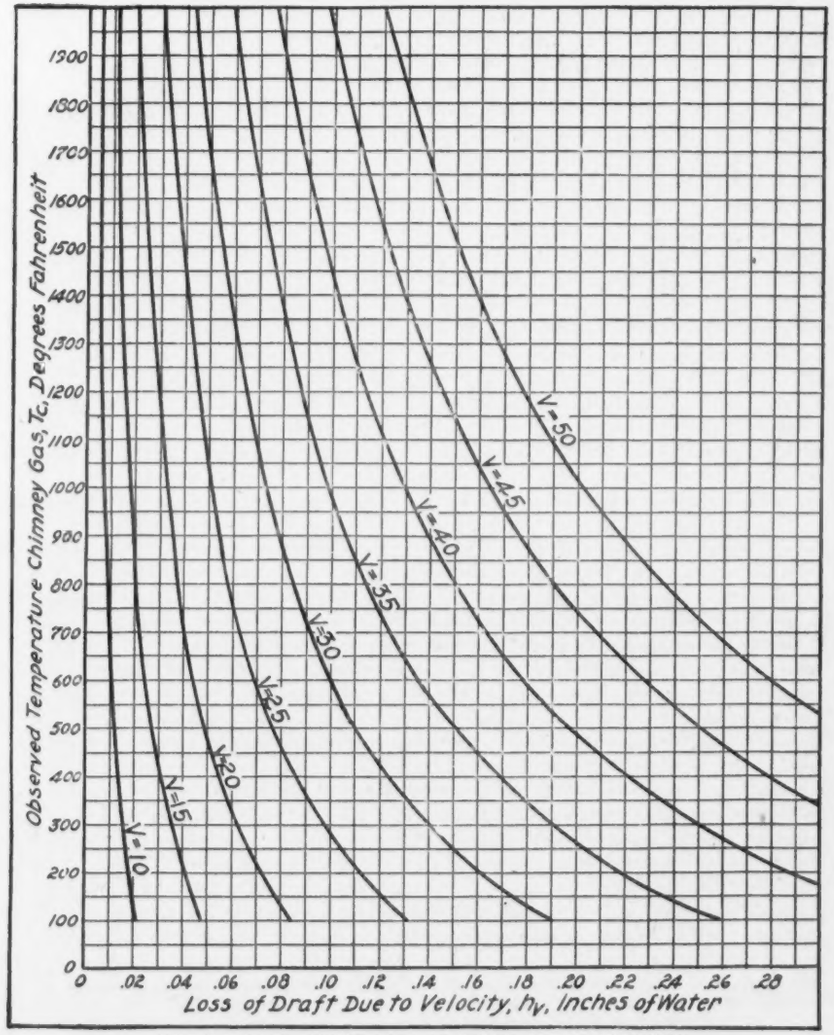


FIG. 2—CURVES GIVING LOSS OF DRAFT DUE TO VELOCITY

Note—This sheet may be cut into two sections, 8 x 7 inches, and may be readily bound in note book form.

Trade Outlook in the Foundry Industry

SHORTAGE and delayed delivery of needed pig iron still continue to cause concern to many foundries. Coke scarcity, due largely to car shortage, is affecting the supply of iron, particularly high silicon grades. A noticeable slackening in demand for iron has taken effect during the past two weeks, due partially to the general knowledge that little first half iron is available and the lingering hope that the present high prices may be lowered for the last six months of the year. Producers are offering little iron at the present time, and indicate a desire to await developments and to estimate their last half costs.

Production Increases

December showed a marked increase in pig iron production, despite the hampering effect of the coal strike which prevailed during several weeks. Although the gain is not as large as that attained in November, and some credit is due to the 31 day month, the tendency toward greater production to meet the unprecedented demand is marked. The total production of all classes of pig iron for December, as reported by The Iron Trade Review, was 2,629,850 tons, an increase of 222,481 tons over the November total. The average daily production for December was 84,334 tons per day, a gain of 4590 tons per day over the preceding month. The effect of fuel restriction, however, is clearly indicated by the ratios of increases. November showed a gain of 32 per cent over the preceding month, while December made only 5.72 per cent advance. The total iron production for 1919 is considerably lower than the two preceding years. This may be attributed in part to the slack demand during the early portion of the year and in part to disturbed industrial conditions during the closing months. Merchant iron production for December was 686,950 tons, an increase of 61,025 tons over the month of November. This was a net gain of 1295 tons per day or 6.2 per cent over the preceding month.

Railways Will Buy

With the date set for the return of the railways to private ownership, hope is renewed for an early buying movement on all classes of equipment. This in turn would induce a strong demand for various grades of castings. The Railway Age estimates that it will require more than three years to bring the rolling stock and equipment of the railroads up to standard again. This is attributed to the small amount of railway buying under government ownership, the pyramided needs for replacements and the extensions which are needed at this time. The estimate presented for the requirements of the next three years includes some 24,500 passenger cars, 712,400 freight cars, and 13,840 locomotives in addition to track, terminal, shop and station construction with the attendant demand for tools and equipment. Malleable and steel shops will benefit largely by a real railway buying movement. The former at the present time are operating at 85 per cent of capacity. Those malleable plants which handle both railway and miscellaneous work are filled with orders for castings other than those required by railways. Malleable shops which make railway castings exclusively are fairly busy upon replacements and urgent repairs.

Shops are Busy

The peak of demand for all classes of castings was not attained during 1919. Starting in the late spring, foundry orders have increased in volume steadily, the acceleration being more marked in gray iron and malleable than was noted in steel and nonferrous lines. No signs of slackening have appeared. Automobile production schedules for trucks, passenger cars and tractors are larger than ever before. Automobile castings are being sought in sections far remote from the assembly plants. Stove and furnace manufacturers still are behind on last year's deliveries. Eastern and southern cast iron pipe makers are unable to make deliveries even during these off months of the year, short of 60 days, and in some cases 90 days or longer are asked. Machine tool builders continue to require a great number of castings to keep up with production schedules. Engines for factory power plant use are strongly in demand. Some engine and special machinery builders in the gulf states are inquiring for castings as far north as Birmingham, Ala. and St. Louis. In the central west and some sections of the east, labor shortage continues to hamper production in many foundries. With the tremendous demand and mounting prices on labor and materials, prices have advanced on practically all classes of castings. The average price for gray iron castings in the Chicago district ranges from $90 to $100 per ton with scaled advances for lighter and more complicated work. In almost every instance, price is made a secondary consideration and the specified time of delivery is a basis upon which castings are bought and sold. Steel foundries still are slower to reach the peak of production attained by other branches of the industry.

Nonferrous prices based on New York are as follows: Copper, 18.87½c to 19.00c; lead, 8.75c to 9.00c; tin, 63.25c; antimony, 10.00c to 10.25c; aluminum, No. 12 alloy, producers price, 31.50c, open market, 30.00c to 30.50c. Zinc is quoted at 9.25c to 9.37½c, St. Louis.

Prices of Raw Materials for Foundry Use

CORRECTED TO JAN. 7

Iron		Scrap	
No. 2 Foundry Valley	$38.00	Heavy melting steel, Valley	$24.00 to 24.50
No. 2 Southern, Birmingham	36.00 to 40.00	Heavy melting steel, Pittsburgh	25.00 to 26.00
No. 2 Foundry, Chicago	40.00	Heavy melting steel, Chicago	24.75 to 25.00
No. 2 Foundry, Philadelphia	42.10 to 43.25	Stove plate, Chicago	33.00 to 33.50
Basic, Valley	37.00	No. 1 cast, Chicago	42.00 to 42.50
Malleable, Chicago	40.50	No. 1 cast, Philadelphia	33.35
Malleable, Buffalo	41.25	No. 1 cast, Birmingham	26.00 to 27.00
Coke		Car wheels, iron, Pittsburgh	32.00 to 33.00
Connellsville foundry coke	$7.00	Car wheels, iron, Chicago	34.50 to 35.00
Wise county foundry coke	8.25	Railroad malleable, Chicago	31.50 to 32.50
		Agricultural malleable, Chicago	33.00 to 33.50

Comings and Goings of Foundrymen

J. P. PERO, who for the past 11 years has been general superintendent and sales manager of the Missouri Malleable Iron Co., East St. Louis, Ill., has retired after 50 years' continuous service in the foundry industry. He will continue to devote a portion of his time to interests which he maintains in various foundry and manufacturing industries in St. Louis. Mr. Pero, who was born in Waltham, Mass., Dec. 9, 1856, belongs to a family which has been prominent in the foundry business of New England for three generations. He was educated in the public schools of Waltham and Worcester, Mass., leaving the Worcester high school in his junior year to become an apprentice molder. This was in February, 1870, when he was only 13 years old. During the following years, until he was made foreman in 1882, Mr. Pero studied the art of molding, specializing in heavy work. Following his first foremanship, he was identified with the management of some of the leading New England and Mississippi valley foundries. His first 30 years in the industry covered gray iron work, while during the past 20 years he has been identified with malleable plants. In 1887, Mr. Pero conceived the idea of an association of foundrymen having for its purpose the exchange of views on technical and practical problems of foundry work. In December of that year he formed the New England Foundrymen's association, which was the original society devoted to educational work among foundrymen in this country. Mr. Pero long has been active in the work of the American Foundrymen's association. He was president of that body in 1916-1917, and has been a director continuously for a number of years.

S. Stoneham, formerly associated with the Union Steel Castings Co., Roxbury, Mass., and before that with the Ohio Steel Castings Co., Springfield, O., has taken the position of superintendent with the Hub Electric Steel Casting Co., South Boston.

Charles F. Hutchins of Worcester, Mass., treasurer of the Standard Foundry Co., of that city, has been appointed a director of the New Finance Corp. of New England, Boston, which recently was incorporated with a capital stock of $1,000,000.

George C. Beebe has been appointed manager of the Cleveland branch of the Columbia Tool Steel Co., Chicago Heights, Ill., in place of E. D. Clarage, who has resigned.

C. R. Pieper has been made general manager of the Iron Products Corp., La Crosse, Wis., which company plans to construct a new plant.

Alphons L. Orschell has resigned as brass foundry superintendent of the Lunkenheimer Co., Cincinnati, and is now associated with the Hill & Griffith Co., of the same city.

James B. Liggett, instructor in foundry practice at Leland Stanford university,

J. P. PERO

Palo Alto, Cal., is making an inspection tour of eastern and middle western states to study foundry practice, particularly in automobile plants.

Herbert J. Roe, works manager of the Adaptable Molding Machine Co., Birmingham, England, returned home recently after spending three months subsequent to the American Foundrymen's association convention in inspecting American industrial plants.

Lawrence M. Brile who has been connected with the United Smelting & Aluminum Co., Inc., New Haven, Conn., as vice president and sales manager for the past five years, severed his connection with that company on Jan. 1 to assume the presidency of Brile & Ratnor, Inc., a New York corporation formed to engage in the metal and chemical brokerage business. Mr. Brile has charge of the nonferrous end of the business, and Mr. Ratnor, one of the best known men in the chemical industry has charge of the chemical department. The office of Brile & Ratnor, Inc., is located temporarily at 115 Broadway, New York.

John L. Nute formerly connected with the Kenneth Fdy. & Mach. Co., Kenneth Square, Pa., is now associated with A. J. McGhee and H. J. Gulden under the firm name of Nute-McGhee-Gulden Co. The company has purchased the entire foundry equipment of the Calvin Gilbert Foundry of Gettysburg, Pa., and has installed it in a building in Chambersburg, Pa., with the object of carrying on a general jobbing foundry business in gray iron, brass, bronze and aluminum.

W. S. Robinson, superintendent of the Benton Harbor Malleable Foundry Co., Benton Harbor, Mich., has been made general superintendent of that company, the Chicago Stove & Range Co., Benton Harbor, and the Muncie Malleable Foundry Co., Muncie, Ind., which now are associated industries. The Muncie foundry until recently was the Whiteley Malleable Casting Co. Oscar Allerton, formerly assistant superintendent of the Benton Harbor Malleable Foundry Co., now is superintendent of the Chicago Stove & Range Co., and his former position will be filled by Herman Crittner. John Moloski, formerly assistant manager of the Benton Harbor plant, has been made manager of the Muncie foundry, and he in turn is succeeded by F. A. Fuller.

P. J. Flaherty recently was elected president of the Johnson Bronze Co., New Castle, Pa., to fill the vacancy created by the death of G. W. Johnson. This company is successor to the American Car & Ship Hardware Co. which was taken over in 1919 and reorganized. Prior to that time the products manufactured in the plant were steam and electric car fittings. After the reorganization this line of manufacture was abandoned and the plant equipped for the production of automobile bronze parts, especially bushings. This entailed the rebuilding of the plant, the scrapping of the old machinery, and the purchasing of proper equipment. At the present time the company is one of the largest manufacturers of bronze bushings in the country.

Testing Society to Meet in Asbury Park

The annual meeting of the American Society for Testing Materials will be held at the New Monterey hotel, Asbury Park, N. J., during the week of June 21. This is a marked departure from the precedent of long standing of holding the conventions of this society at Atlantic City.

The growth of this organization during the past year is indicated by the election of 401 new members, compared with 303 for 1918, and 362 in 1915, which represented the greatest accession in membership during a 12-month period until the record established last year. The net growth in membership was 249, making the present total membership 2572.

Acquires East St. Louis Malleable Plant

The National Malleable Castings Co. has added another property to its manufacturing facilities in the purchase of the plant of the Missouri Malleable Iron Co., one of the oldest industries of East St. Louis, Ill. The East St. Louis plant has an annual capacity of about 20,000 tons of malleable products. Possession of the new property was assumed on Jan. 2, 1920. F. E. Nulsen, president of the Missouri Malleable Iron Co., is retiring from business and his son, John C. Nulsen, will be manager of the East St. Louis plant. E. W. Felger will fill the position of local treasurer. Acquisition of this plant gives the National company seven malleable iron casting plants, located at Cleveland, Chicago, Indianapolis, Toledo and East St. Louis. It also has steel castings plants located at Sharon, Pa., and Melrose Park, Ill.

Grinnel Co. Inc. Assumes Extinguisher Lines

All of the sales and contracting business formerly carried on by the General Fire Extinguisher Co. was taken over by the Grinnell Co., Inc., on Jan. 1, 1920. The change was made because the old name so specifically described the automatic fire protection section of the company's business that it did not cover the company's several closely related lines of business including fire protection, power and process piping, steam, hot water and gas heating, drying, and sales of pipe, valves and fittings.

British Products Shown in Brazil

The great extent to which American manufacturers and exporters of iron and steel, engineering materials and hardware have taken advantage of the opportunities afforded them in Brazil by the war may be judged by the Brazilian trade returns. These reports show that although German competition has been practically destroyed, British manufacturers are now faced with still more serious competition from one of the most highly developed manufacturing countries in the world. The seriousness of the situation has roused the officers and members of the British chamber of commerce of San Paolo and southern Brazil to closely study and initiate means for outstripping their competitors. With the object of influencing Brazilian importers to purchase British goods arrangements have been made to hold a series of British industrial exhibitions in the city of Sao Paolo which is the heart of the great manufacturing district of Brazil and, indeed, of South America. The first of these exhibitions, extending from Dec. 1, 1919, to Feb. 28, 1920, comprised small hardware goods and other lines allied to the hardware trade.

Starts Construction of New Building

The Buckeye Tractor Ditcher Co., Findlay, O., has started the foundation for a new foundry building, 100 x 220 feet. The building will be of brick and steel construction and will be modernly equipped with electric traveling cranes, molding machines and other facilities for handling work to advantage. It is the intention of the company to make all its own gray iron, electric steel and brass castings in the new shop.

The Kenney Foundry & Mfg. Co. plant, Mansfield, O., was destroyed by fire on Jan. 1. The company is seeking a location nearby to resume operations at the earliest possible date.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The Automotive Tractor Co., Frederick, Md., contemplates the erection of a plant, 50 x 200 feet.

The plant of the Grand Haven Brass Foundry, Grand Haven, Mich., recently was damaged by fire.

The Reliable Stove Co., Cleveland, is said to be planning the erection of a plant, 60 x 120 feet.

Alterations to its plant are being planned by the Estate Stove Co., Hamilton, O.

Erection of an addition to its foundry is contemplated by the Superior Iron Works, Superior, Wis.

The plant of the Atlantic Foundry Co., near Cuyahoga Falls, O., which was recently damaged by fire, will be rebuilt.

The National Cash Register Co., Dayton, O., is reported to have had plans prepared for the erection of a foundry, 165 x 500 feet.

Erection of a pattern shop, 1-story, 58 x 168 feet, is contemplated by the Toledo Machine & Tool Co., Toledo, O.

Erection of a plant, 55 x 160 feet, is reported to be contemplated by the New Process Stove Co., Cleveland.

The erection of plant extensions are reported to be planned by the Zanesville Malleable Co., Zanesville, O.

The General Engineering Co., Alpena, Mich., John Lundberg, president, contemplates the erection of a foundry and machine shop, 70 x 80 feet.

The capital stock of the Flint Foundry Co., Flint, Mich., recently was increased from $50,000 to $100,000.

Capitalized at $40,000, the Glenwood Foundry, Philadelphia recently was incorporated by W. R. Nicholson Jr. and others.

A site on which it plans the erection of a modern plant has been purchased by the American Range Foundry Co., St. Louis.

The capital stock of the Johnson City Foundry & Machine Co., Johnson City, Tenn., recently was increased from $10,000 to $100,000.

Erection of a 90 x 100-foot addition to its plant is contemplated by the Baltimore Car Foundry Co., Baltimore.

The capital stock of the Hercules Gas Engine Co., Evansville, Ind., recently was increased from $250,000 to $500,000.

The Imlay City Foundry Co., Imlay City, Mich., recently was organized with $25,000 capital, by P. W. Mulder and others.

Plans have been drawn for the erection of a foundry, 96 x 110 feet, for S. E. Shaecht, 1700 Prairie avenue, Elkhart, Ind.

The W. W. Sly Mfg. Co., 4700 Train avenue, Cleveland, contemplates the erection of a storage building, to be 1-story, 50 x 65 feet.

The Erie Foundry Co., Erie, Pa., has had plans prepared for the erection of a plant, to be 81 x 204 feet.

The W. J. Westbrook Elevator Co., Greensboro, N. C., is reported to be planning the erection of a foundry.

Capitalized at $25,000, the Reedsport Iron Works, Reedsport, Oreg., has been incorporated to engage

in iron working, machine shop and foundry practice, by Arthur J. Brews, Winnie Brews and D. A. Smith.

The Miami Brass Foundry and the Miami Mfg. Co., Dayton, O., each headed by Ben Semmelman, will erect a plant.

Plans have been completed for the erection of a building of frame construction for the Specialty Foundry Co., Portland, Oreg.

The Frost Mfg. Co., Kenosha, Wis., has increased its capital from $200,000 to $400,000 and will erect additions to its foundry and machine shop.

Work has started on the erection of a plant for the Engman-Matthews Range Co., Goshen, Ind. The building will be 80 x 1000 feet.

The George J. Meyer Mfg. Co., 576-598 Clinton street, Milwaukee, is considering plans for extensive enlargement of its foundry and machine shop.

Foundries, Ltd., Ottawa, Ont., has been incorporated with $24,000 capital, by Frederick Menagh, Harold E. Morrani, Alfred Blake and others.

Fire damaged the main building and the east wing of the plant of the Hope Foundry Co., Auburn, R. I., manufacturer of gray iron castings.

The plant of the Freeland Foundry & Machine Co., Freeland, Pa., recently damaged by fire, will be rebuilt.

The Universal Winding Co., Auburn, R. I., has started work on the erection of two additions to its foundry.

The McInnerney Co., Council Bluffs, Iowa, recently was incorporated with $250,000 capital to operate a general machine shop and foundry, by B. McInnerney, E. A. Wickham, E. H. Lougee and others.

The Advance Pump & Compressor Co., Battle Creek, Mich., is erecting a foundry, machine shop, power house, testing room, blacksmith shop and warehouse, which will double its capacity.

A plant, 60 x 200 feet, will be erected by the Regle Brass Co., Greenville, Mich., which was recently incorporated with $100,000 capital. J. B. Couture is president and general manager.

The C. & G. Pattern Works, Indianapolis, recently was incorporated with $10,000 capital, by F. D. Crider, Charles J. Gisler and A. H. Gisler, to manufacture iron patterns.

Construction of a foundry unit, 60 x 160 feet, has been started on a site of seven acres, recently purchased by the J. C. Green Foundry Co., Vassar, Mich. J. C. Green is president.

Architects Dowitz & Webb, 232 St. Paul street, Baltimore, is preparing plans for the erection of a foundry and machine shop, 60 x 300 feet. The name of the owner is withheld.

The Mascot Stove Mfg. Co., Chattanooga, Tenn., has leased a plant and will remodel it for the manufacture of ranges. The capacity of the plant will be trebled.

The Bowen Foundry, Machine & Electrical Co., Harlan, Ky., recently was incorporated with $20,000 capital, by C. D. Bengey, C. H. Winfrey and M. L. Bowen.

The Boicourt Machine Co., Ft. Worth, Tex., which was recently incorporated with $30,000 capital, is reported to be planning the erection of a gray-iron and brass foundry.

Capitalized at $500,000, the Rail Welding & Foundry Co., Wilmington, Del., recently was incorporated by T. L. Croteau, H. E. Knox and S. E. Dill.

Capitalized at $30,000, the Mid-West Foundry Co., Marion, Ind., recently was incorporated to engage in a general foundry business, by Otto Brunka, Fred Brunka and A. Williams.

The Ozaukee Heater Co., Saukville, Wis., manufacturer of oil-burning heating devices, will erect a gray-iron foundry, by making an addition to its present machine shop.

The Charles H. Stehling Co., 401 Fourth street, Milwaukee, has purchased the gray-iron foundy at Cedarburg, Wis., from the Western Rope & Mfg. Co. of Oklahoma.

R. Nelson Molt, Millbury, Mass., Samuel Seder and Samuel G. Nash, recently were named as the incorporators of the Vulcan Foundry Co., Worcester, Mass., which was chartered with $10,000 capital.

Capitalized at $10,000, the Hammond Malleable Iron Co., Hammond, Ind., recently was incorporated by H. J. Wanner, H. C. Wanner and B. J. Steelman.

The plant of the Birmingham Machine & Foundry Co., Birmingham, Ala., recently was damaged by fire.

Bennett & Seeley, Inc., Bridgeport, Conn., has been incorporated with $50,000 capital, by F. A. Bennett, E. E. Seeley, New Haven, Conn., and F. E. Morgan, to deal in mill and foundry supplies.

The Merrimac Valley Iron Foundry Co., Amesbury, Mass., recently was incorporated with $3000 capital, by Louis Caouette, Fred Gonthier, Newburyport, Mass., and Arthur Cromier.

Announcement has been made to the effect that the Reading Iron Co., Reading, Pa., has purchased the plant of the E. & G. Brooke Iron Co., at Birdsboro, Pa.

The Dunham Co., Berea, O., has leased the foundry of the Hasting Iron & Foundry Works, Hastings, Mich., and will organize it for the manufacture of land rollers, auto parts, etc.

Capitalized at $150,000, the New England Brass Foundry Co., Worcester, Mass., recently was incorporated as a subsidiary of the Coppus Engineering & Equipment Co., by H. C. Coppus, Otto Wechberg and Linwood M. Erskine.

Capitalized at $200,000, the Erie Stove & Mfg. Co., of Canada, Ltd., Montreal, Que., recently was incorporated to manufacture heating appliances, etc., by Frank B. Common, Francis Bush, Herbert W Jackson and others.

The Meadows Mfg. Co., Bloomington, Ill., has completed the erection of the first one of a group of factory buildings. This structure is a foundry building, 90 x 260 feet. The next unit to be erected will be used for a core room and pattern shop.

The gray-iron foundry of the former Janesville Machine Co. at Janesville, Wis., now a part of the Samson Tractor Co., will be enlarged by the erection of an addition, 120 x 180 feet. The present foundry and machine shops are being remodeled.

Architects are at work on plans for the erection of an addition to the plant of the E. H. Bardes Range & Foundry Co., Cincinnati. The addition will be 85 x 102 feet, and will be used as a core room and pattern shop.

In order to increase its production, the Cabco Iron Works, Inc., Diamond Bank building, Pittsburgh, recently increased its capital. At present the company is not in a position to announce its plans for increased output.

Plans have been prepared for the erection of a foundry, 170 x 700 feet, for the Lycoming Foundry & Machine Co., Williamsport, Pa. When completed it will be devoted to the production of automobile engine castings. J. H. McCormick is general manager.

Plans have been completed for the organization of the Franklin Die Casting Corp., Syracuse, N. Y., with a capital of $1,000,000. Howard L. Franklin is to be president, H. C. Skinner, vice president, and C. E. Hull, secretary and treasurer. The company will erect a plant.

The Jorgenson Mfg. Co., Waupaca, Wis., maker of brass specialties and gas engine parts, has increased its capital from $70,000 to $350,000 and will spend about half of the new issue for buildings and machinery. P. J. Jorgenson is president and general manager.

The Production Foundries Co., Ann Arbor, Mich., recently increased its capital from $100,000 to $200,000, in order to permit the payment of bonded indebtedness and to provide funds for additions to its plant. Enlargement of the works will not be started until spring, and will consist chiefly of an addition to the molding floor.

The Pullman Co., Chicago, is making extensive improvements to its establishment. These improvements comprise the erection of a 3-story building of approximately 293,000 square feet of floor space, a press building, 80 x 200 feet and the remodeling of the Union Foundry buildings, providing approximately 190,000 square feet of floor space.

The Racine Confectioners' Machinery Co., Racine, Wis., plans to erect a 2-story building, 50 x 165 feet and an adjoining structure, one story, 40 x 145 feet. No new equipment for these buildings will be needed other than a traveling crane for the 1-story unit, which will have about a 36-foot span. Construction will start as soon as the weather permits.

The Flint Pattern & Foundry Co., 519 Bush street, Flint, Mich., has plans for the erection of a plant, 40 x 100 feet, part two stories. The first floor will be used as a foundry, which will be equipped with four furnaces of gas or oil type, two coke fired furnaces, molding machines, etc. The upper portion of the building will be devoted to the manuacture of bronze bushings.

The National Malleable Castings Co., Cleveland, has added another property to its rapidly-extending chain of foundries, in the purchase of the plant of the Missouri Malleable Iron Co., East St. Louis, Ill., which has an annual capacity of 20,000 tons of malleable-iron castings. Acquisition of this plant gives the National Malleable Castings Co. five malleable-iron foundries, located at different cities throughout the country.

Announcement of the organization of the Automotive Foundry Co., at LaCrosse, Wis., has been made, and the company has purchased a site on which it plans to erect a plant, 100 x 220 feet, contract for which has been let. The concern will specialize in the manufacture of motor pans, cylinder heads and other auto engine parts, and high-grade casting work. The company is capitalized at $100,000, and O. B. Dibble is one of the officers.

A partnership formerly composed of S. K. DeHart, R. H. Chilton and H. L. Beaty, Nashville, Tenn., has been discontinued and a company formed to take over the plant and be known as the DeHart & Chilton Machine & Foundry Co. The company will operate an iron foundry, a brass foundry and blacksmith and machine shops. The company is capitalized at $50,000 and the incorporators are S. K. DeHart, Katherine DeHart, I. M. DeHart, B. B. Cranch and H. L. Beatty. The company will probably be in need of equipment, but at this time is unable to state its requirements.

New Trade Publications

LIFT-TRUCKS.—A 4-page folder is being circulated by the Barrett-Cravens Co., Chicago, in which the use of lift-trucks in the core room is described. The folder is entitled, "Scientific Methods in the Core Room."

BOLTS.—The Columbus Bolt Works Co., Columbus, O., has published a large catalog in which bolts, nuts, carriage and automobile forgings are described and illustrated. Complete specifications are given. One section of the booklet contains some interesting data and tables.

VALVES.—A cloth-bound 156-page catalog, has been published by the Nelson Valve Co., Philadelphia, in which bronze, iron and steel valves, gate, globe, check and nonreturn valves are described and illustrated, and specifications, etc., given. The various valves are illustrated.

WOODWORKERS' VISE.—An illustrated folder is being circulated by the Oliver Machinery Co., Grand Rapids, Mich., in which a woodworking vise is described and illustrated. This vise, according to the folder, can be adjusted easily and speedily to any desired angle by a large hand operated collar and is clamped into any tilted position by a rack bar. All parts are interchangeable. The folder also states that the vise may be set at any point in a 90 degree arc and be rotated and set at any point desired within the complete arc of another circle at right angles with the former, without loosening the work in the jaws.